



Three Rivers Park Lighting Strategy



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Introduction Art2Architecture

As a combined European and North American team we believe that our shared transatlantic experience is an important starting point, helping us to unlock new possibilities similar to the way the experience of the physical regeneration of several North American cities such as Seattle and Baltimore has affected the water front regeneration of European cities in the early seventies.

The night time appearance of a city is closely linked to its day time urban, economic, cultural and social context. Any lighting strategy, even when focused on a seminal development such as the Three Rivers Park must be therefore located in this dynamic to avoid addressing only technical issues or being solely concerned with how buildings, civil engineering structures and public realm spaces could look when lit.

In the Three Rivers' Park Lighting strategy our primary focus is on the exploration of how lighting can contribute to the realisation of its vision of a world class public realm. In parallel to this we are interested in exploring how lighting could become a part of the process of reintroducing the rivers back into peoples lives. In the case of a project such as Three Rivers Park, a lighting strategy therefore needs to be integrated into an orchestrated effort to re galvanize the city and its people.

In this context it is important to see the Lighting Strategy for the Three Rivers Park not only within the aspirations and vision of

the park itself, but also in the associated context of the night time economy of the downtown area and the broader context of positioning Pittsburgh as a prime 21st century city.

We believe that even a partial implementation of the lighting strategy in this context could play an important role as a catalyst for the current communal aspirations. The lighting strategy must be both creative – 'thinking outside the box' – and practical – 'keeping our feet on the ground'. Why? Because an inspiring vision must work, and deliver a tangible difference to the quality of people's lives. The beneficial effect of a well-implemented lighting strategy in a city can be seen and measured by:

- higher earnings in the night time economy and tourism
- increase in inward investment
- lower energy costs and environmental benefits
- reduction in levels of crime and fear of crime
- the beneficial effects of cultural revival and celebration in peoples lives

The transformation of Three Rivers Park with light could become a powerful recognition of the fact that people's aspirations change more rapidly than the physical environment itself.

The Three Rivers Park Lighting strategy provides a unified approach to lighting, forming a basis for proposed or future individual concept designs as well as providing guidance for people and organisations

interested in investing in lighting to add value to neighbourhoods and commercial developments. As a first step towards a fully integrated approach to lighting, the Lighting strategy provides a reference framework avoiding only detailed design responses.

The Lighting strategy and the City

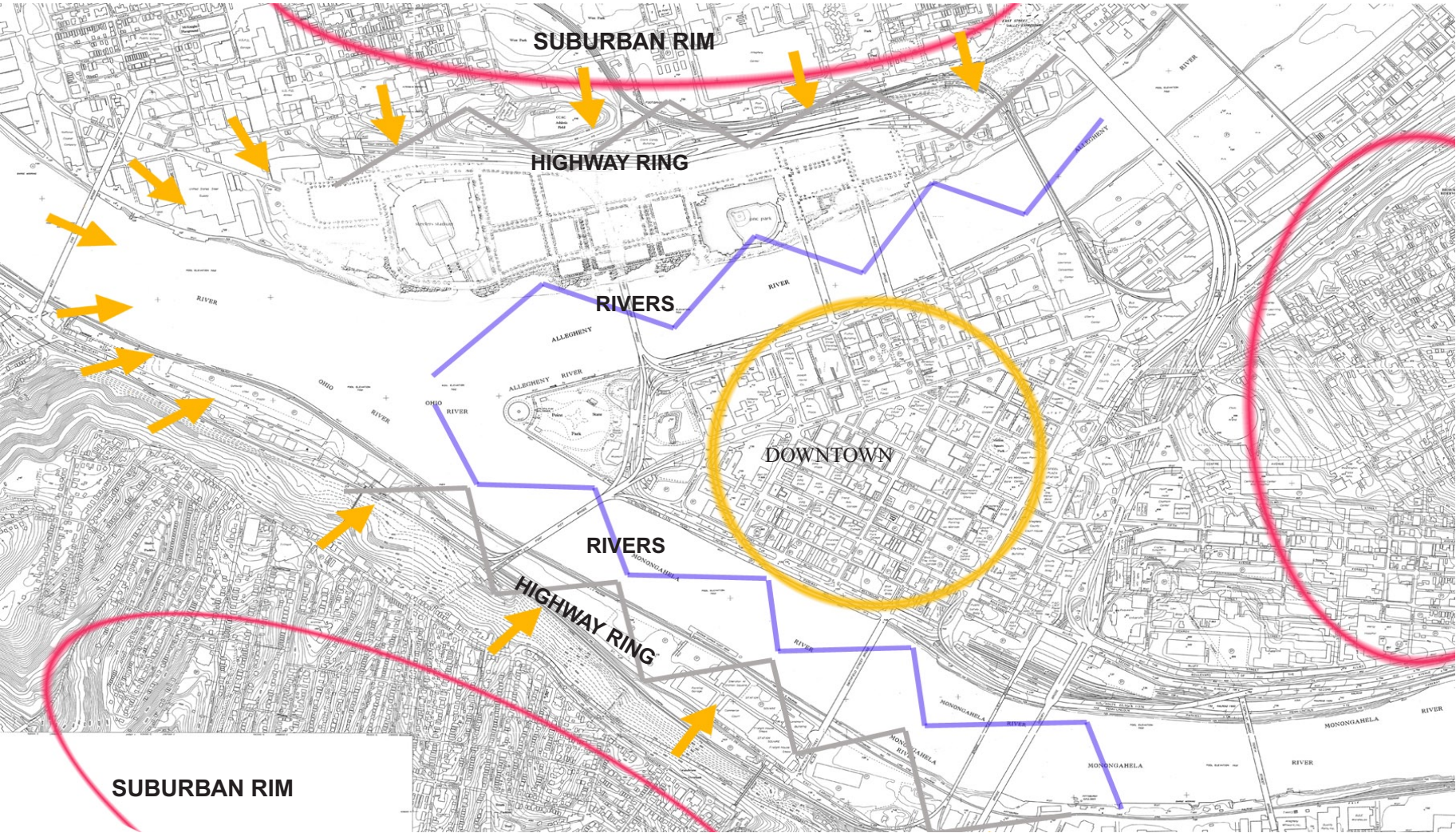
To understand the future role of lighting in the context of the Three Rivers Park one needs to understand how the current lighting of the downtown, including areas of the riverfront, has evolved as a response to how people perceive and experience their city. Despite the diverse lifestyles experienced by inhabitants of a city on a daily basis, within the fabric of an urban subtext are woven the common threads of a shared mental map. This mental map binds people’s individual experiences into a collective, mutual understanding of the city, which often dramatically diverges from the way the city is seen by outsiders: their familiarity with its systems, with its streets, with its sights and sounds, with its light and shadow.

Lighting of any city is very much a part and result of this shared mental map, reflecting the way people move through the city and how their resulting behaviour affects the well being of the city itself.

The origins of the current mental map of Pittsburgh can be traced to the period of the first regeneration (1946 -1969), which was principally driven by emerging economic and environmental agendas, culminating in significant pollution control laws and strategies for redevelopment of areas formerly used for heavy industry. The regeneration momentum expressed itself symbolically through the creation of Point State Park at the confluence of the Allegheny, Monongahela and Ohio`rivers in the heart of downtown. While Pittsburgh remade itself into a city with clean air and clean water, a contrast began to emerge between the outsiders’ and insiders’ views of the city. The insiders’ view was critically moulded in this period of change by the combined effects of suburban allure followed by economic downturn with changes in neighbourhood demographics.

The psychological aspect of this emerging new mental map of Pittsburgh as an “outside in” city started to displace the old mental map of the city centred on the downtown, bringing with it a focus on living in the surrounding suburban residential rim. This “outside in” mental map of Pittsburgh became embedded in people’s minds during the subsequent decades when the city, once a world leader in steel production, was faced with serious changes in the economics of the industry. During the second phase of urban regeneration Pittsburgh built further on the foundation of the laws and planning efforts of the earlier decades focusing on economic development rather than restoring the natural environment.

Pittsburgh once again needed to align its economic and environmental goals. Public-private partnerships became the strategy of the 1980s for providing the massive infrastructure needed to attract private development to these large sites. Whilst new communities were built on many of the industrial sites that had been left idle on the riverbanks, the mental “outside in” map of the downtown and the rivers still continued to mould most peoples perceptions.



Outside In Mental Map

Just like in the previous decades, a similar discrepancy existed between the external view of Pittsburgh as a world leader in brown field development and the continuity of the “outside in” mental map.

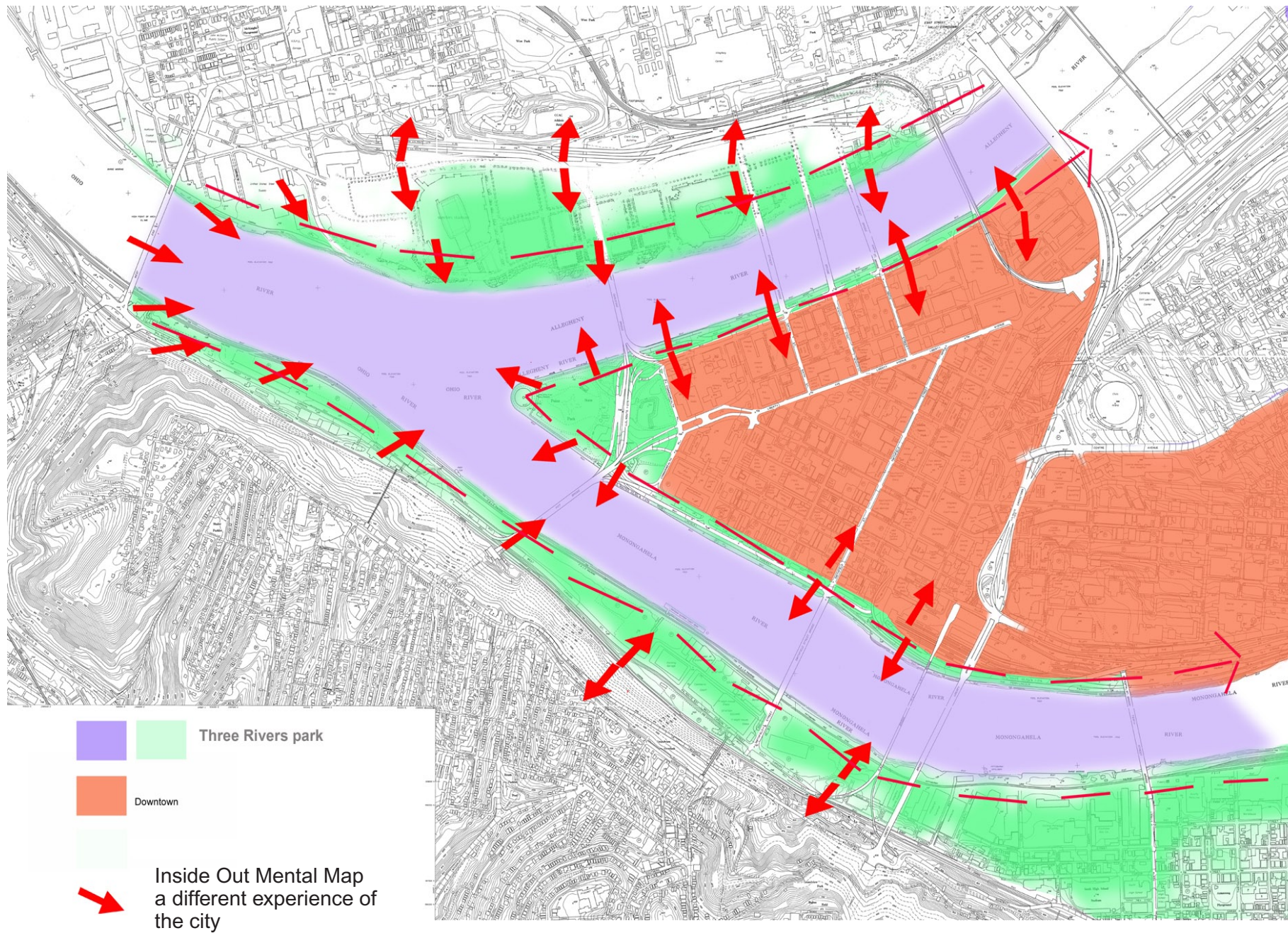
“It was a perception problem, during the Reagan Depression of the early 80’s, Pittsburgh politicians couldn’t mention reusing industrial land for something other than creating jobs. All through that decade the political viewpoint of aiding the region was in creating jobs, that meant manufacturing jobs. It was political suicide to suggest otherwise.” E.K.Muller Proffesor of history at Pitt

Downtown as a destination

The downtown in this “outside in” mental map is seen as a destination accessible predominantly by car through a number of obstacles such as crossing the rivers and negotiating a ring of expressways. In terms of lighting, the effect of the “outside in” mental map led to a one sided focus on lighting of inner city roads and parking lots, which often created an unnecessary high level of luminance with little regard of its effect on the rest of the city.

Correspondingly, the disjointed and disparate lighting in many parts of the downtown and of the Allegheny and Monongahela riverfronts is an expression of the limited importance given to the night time experience of a walkable and explorable city.

The continuation of the “outside in” mental map in people’s minds today, with its psychological origins in the extensive suburbanization followed by a dramatic collapse of its heavy industrial base, is also related to the subsequent substantive population decline and the rising age demographics. The anticipated stabilization of the population decline during the current decade opens a genuine opportunity for Pittsburgh to move into the 21st century as a city where sustainable development balances economic, social and ecological health as the key to continued prosperity and overall quality of living.



The Social Dimension of Public Space

Public spaces are open to all, regardless of ethnic origin, age or gender, and as such they represent a democratic forum for citizens and society. When properly designed and cared for, they bring communities together, provide meeting places and foster social ties of a kind that have been disappearing in many urban areas. These spaces shape the cultural identity of an area, are part of its unique character and provide a sense of place for all.

CABE Green Space Manifesto

When completed, Three Rivers Park will demonstrate the immense value of bringing people back to water and making the rivers a lasting engine for prosperity.

Three Rivers Park as a network of significant public realm spaces will give people an unparalleled 24/7 new experience of their city. In contrast to the outside in mental map this experience will be based on a more intimate and direct interaction with the city and its natural setting.

Pittsburgh today

The 21st century will be the century of cities. For the first time, over half of the world's population will live in cities.

Successful cities have some things in common- visionary individuals, creative organisations and a political culture with a clarity of purpose. They all seem to follow a determined, not a deterministic path. An appreciation of cultural issues, expressing values and identity, becomes an important key to the ability to respond to change.

A culturally informed perspective for a city becomes crucial in making urban planning work. Successful cities also recognise that 21st century's problems can't be solved with 19th century's mindset as the dynamics of cities and the world urban systems have dramatically changed.

The value added to the economic well being of a 21st century Pittsburgh will be created less through what is manufactured and more through intellectual and creative capital applied to products, processes and services.

Liveability as an urban quality will require a realignment of people's mental map of Pittsburgh and the recognition that no one can shape urban change alone. The liveable city is about wholeness - connectedness - interlining, a network, rather than a hierarchy, based on a process of bridging divisions between disciplines, institutions and public, private and voluntary sector approaches.

The effect of a premier city is well recognised as those cities have succeeded in making the global economic and social conditions work for their benefit. Leading cities have also demonstrated considerable innovation in dealing with change as opposed to just passively managing decline. The effect of the practical allure of liveable vibrant cities can be seen not only in terms of incoming investment but also, most crucially for cities like Pittsburgh, in a dramatic effect on the cities demographics both in lower age profile and sustainability of population numbers.

Pittsburgh is uniquely poised to become such a world class premier city as it has many of the necessary qualities: evolved infrastructural attributes such as public transport, health, education and culture provision as well as its highly attractive geographic location and natural setting.

The Three Rivers Park embodies many of these qualities as one of the cities most important public realm spaces and focus for investment. Lighting clearly has a role in the development of these qualities through an imaginative approach to lighting with a sense of place making.



Lyon's low level of light pollution and the adopted hierarchy of lighting as implemented on major and minor vehicular routes



Lyon Light festival opening parade



Temporary Light Art installation

Lyon model as a concept and starting point

The experience and achievements of Lyon offers many useful pointers for the development of lighting design in the Three Rivers Park and its integration into downtown Pittsburgh. Lyon's particular focus on seeking a synergical benefit from both permanent and temporary lighting projects demonstrates the capacity of light to reignite in peoples minds a shared and creative vision of their environment .

The underlying principle in Lyon's approach is an uncompromising commitment to excellence and innovation in lighting design as well as a commitment to delivering tangible related benefits to the city.

Lyon, the natural crossroads between northern Europe and the Mediterranean shoreline, is located in the heart of the Rhône-Alpes region, bordered by the Alps to the East and the Massif Central to the West, with the natural Saône-Rhône river valley running down the middle. Lyon was made a World Heritage site by Unesco in 1998, thus reinforcing its international influence.

Lyon has implemented a far reaching lighting strategy since the mid 80s, which resulted in a thorough transformation of its night time environment. Since 1989, the Lyon town administration has set yearly targets regarding public lighting conveyed by the systematic integration of the lighting concept in town planning and the development of public spaces.

The city's technical services, in partnership with independent lighting designers, orchestrated the implementation of the Public Lighting Program. This effort required new and rigorous methods of analysis and definition of a coherent collaborative atmosphere. A partnership between the public and private sectors brought together the necessary technical means and know-how. Other participants such as building administrators, hotels, department stores and public establishments, such as Electricité de France, contributed to the beautification of the city and the success of the program by illuminating their own buildings.

The extent of this decade-long transformation made Lyon a world leading example of how:

- functional lighting can be more pleasant, reassuring and environmentally efficient
- natural sites and the architectural heritage of a city can be enhanced with light
- pedestrian, cyclist and vehicular routes can be made legible and interesting during night time

The lighting programme also became the showcase for best lighting designers participating either by invitation or through competitions organised by Lyon.



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1. 2. 3. Example of how lighting of key landmark buildings can increase the legibility of a city as well as create memorable panoramic vistas

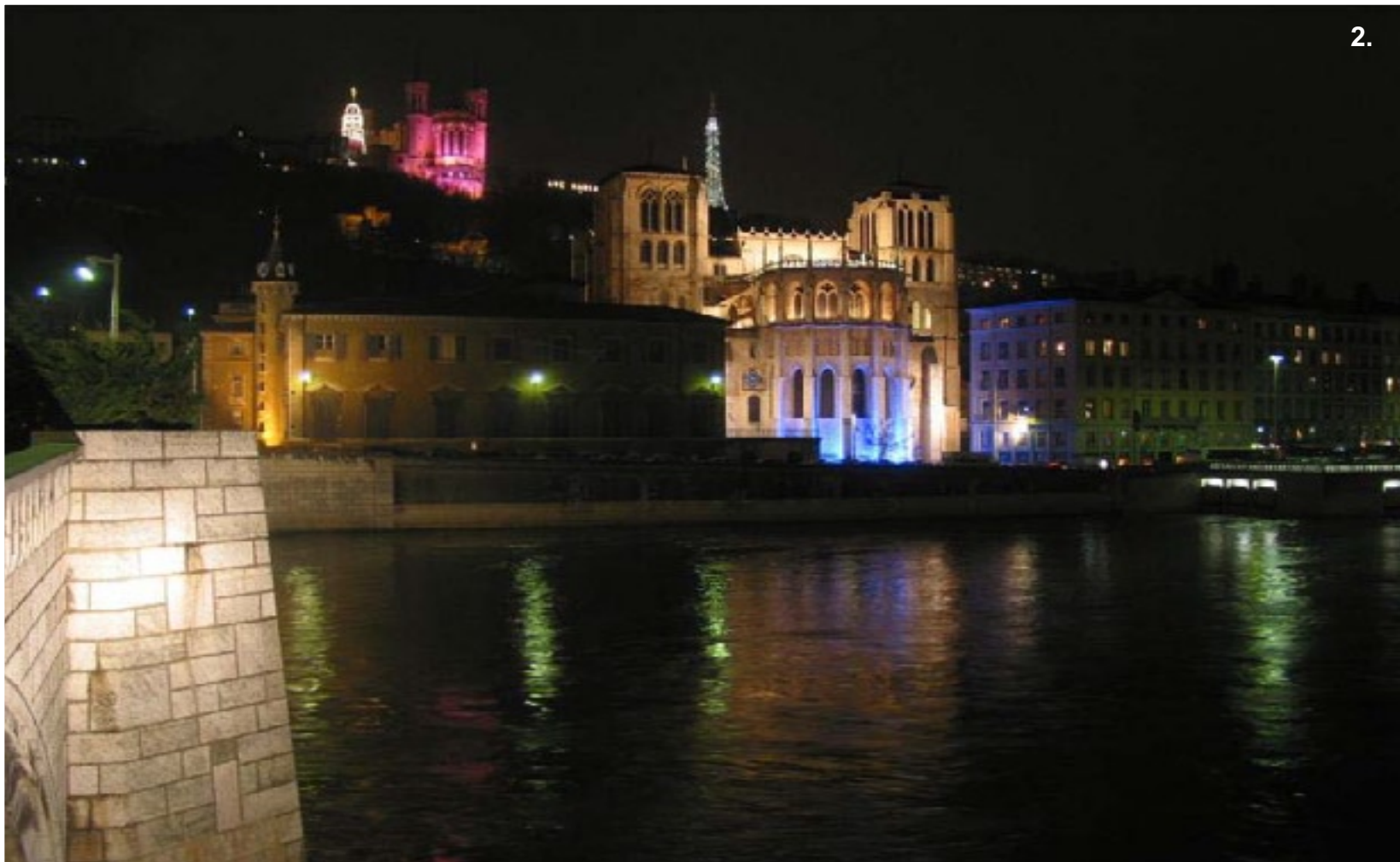
“Today, lighting architecture is helping to make our city even more beautiful,” states Gerard Collomb, Mayor of Lyon. “Every night of the year, the Lighting Plan illuminates more than 200 sites in our city, and the December 8th celebration gains in momentum and renown.”

Lyon’s approach to lighting is also particularly successful in creating a major tourist attraction in the form of the Fête des Lumières (Festival of Lights), held for four days in early December. The festival which originally revived a traditional religious and festive event is today seen as an opportunity for the creative exploration of light, mixing large scale scenography with light artworks, street entertainment and activities, thus reaching large audiences travelling to Lyon from all over Europe.

The Festival is also accompanied by a symposium and series of public lectures and presentations aimed at exploring issues of lighting in cities.



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1. Example of how a well-lit bridge can create a connection between architecturally distinct neighbourhoods and a strong sense of place
2. Example of how lighting can create a balanced panoramic view with a sensitive balance between darkness and light and a judicious use of color light
3. Example of how lighting can successfully harmonise a disparate public space with a strong emphasis on a clear hierarchy of lighting effects



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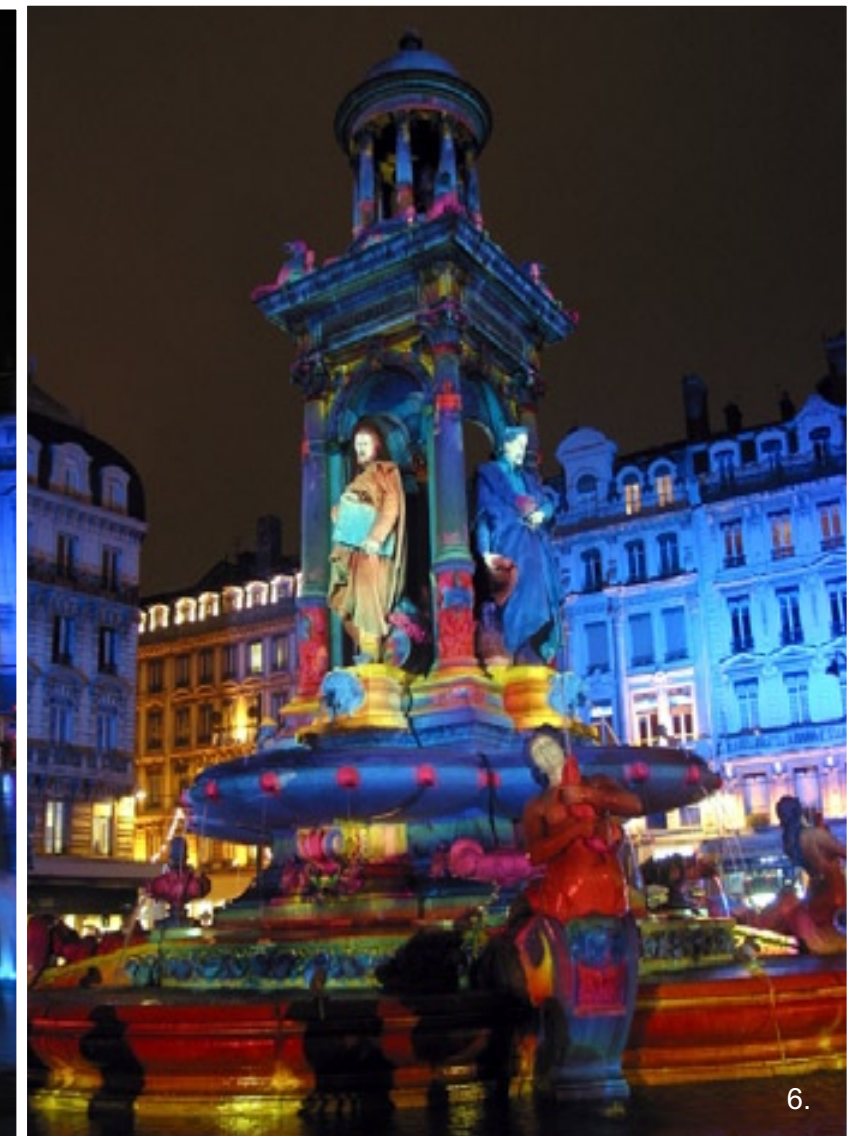
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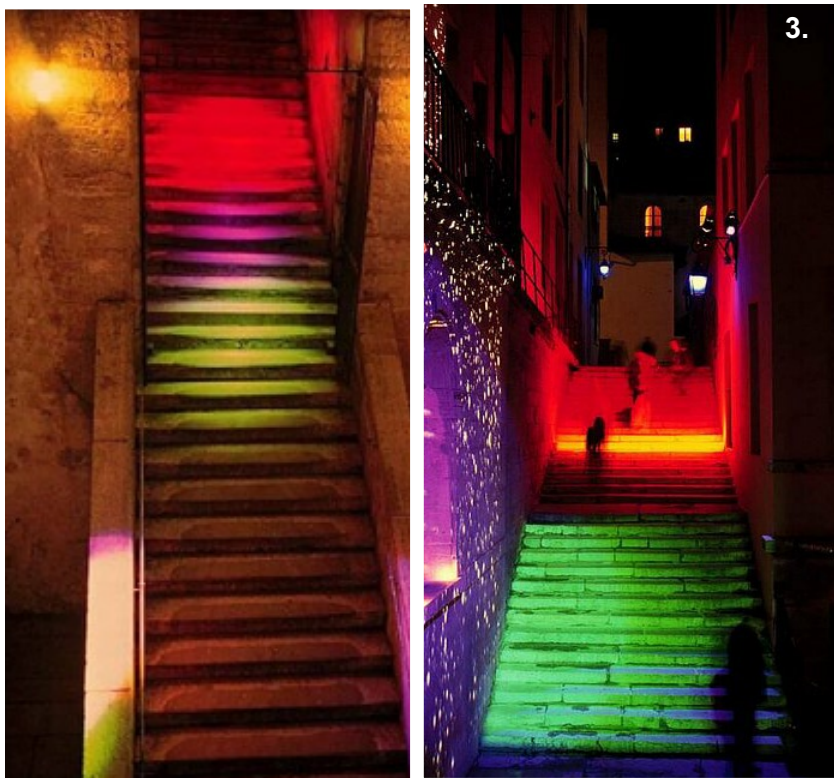


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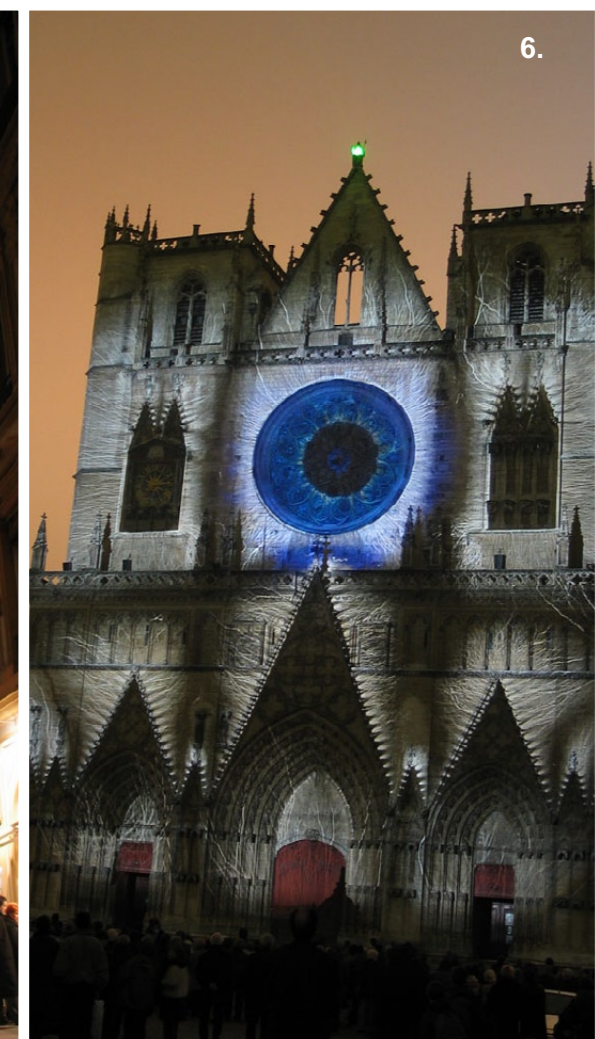


6.

Illustration: 1. Laser and light show 2.3.4.5.6. Large scale projection on buildings as a part of audience based performances



Illustrations 1. Large scale projection 2. Temporary lighting of a historic building 3. Temporary lighting of a connective corridor 4. Permanent lighting of a square



Illustrations: 1. Large scale projection 2. searchlight display programmable by the public 3. 4.. Temporary illumination 4. Permanent illumination of a church . 5. Large scale projection



The existing night time panorama of Pittsburgh dominated by the vertical effect of its downtown buildings nestling in the confluence of the rivers flanked by Mount Washington is already recognised as one of the most attractive in North America.

*To gild refined gold, to paint the lilly,
To throw a perfume on the violet,
To smooth the ice, or add another hue
Unto the rainbow, or with taper-light
To seek the beauteous eye of heaven to garnish,
Is wastefull and ridiculous excess.*

William Shakespeare - King John, Act IV, scene ii

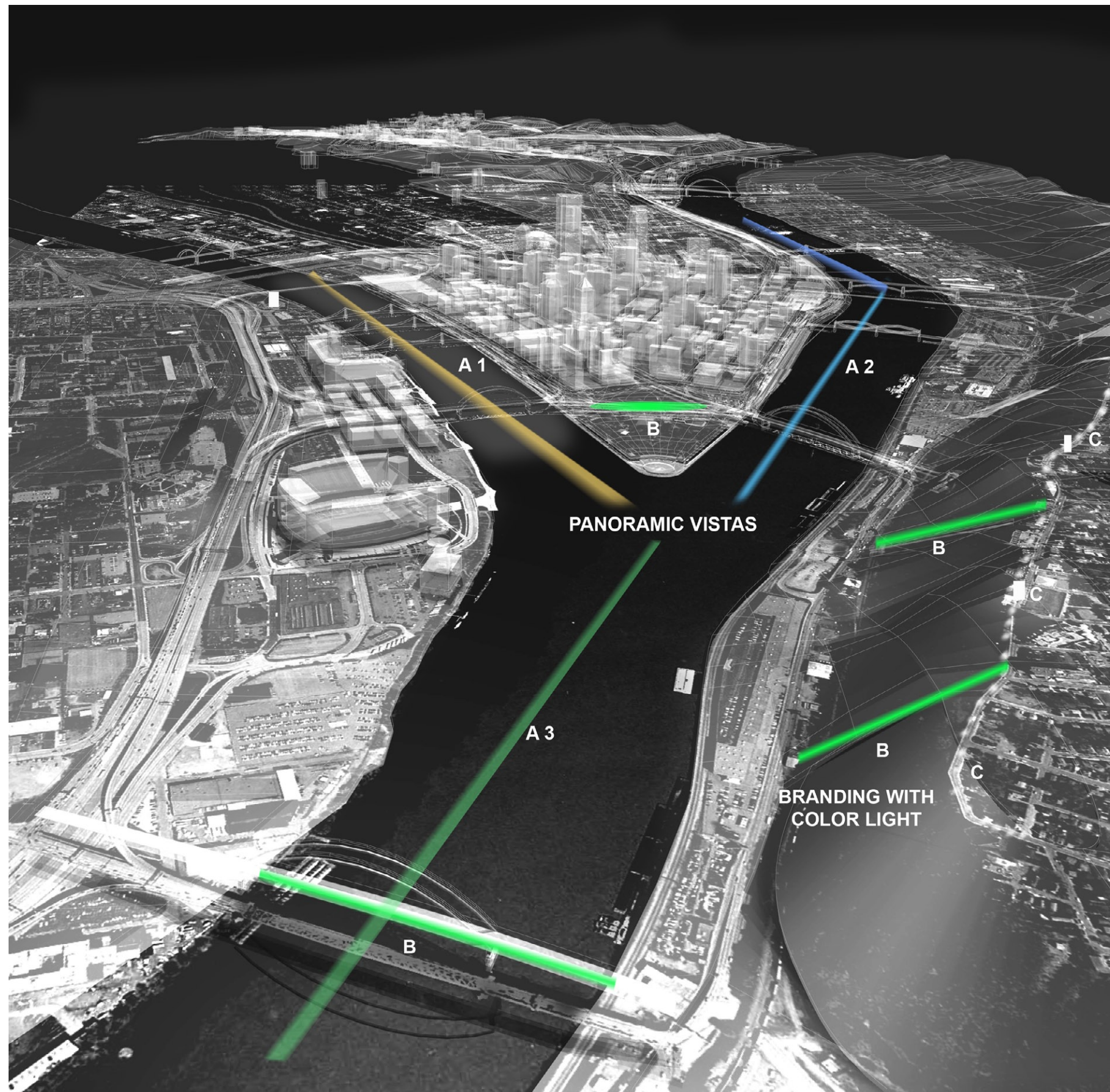
Composing a bigger picture

The Urban principles of the Lighting strategy for the Three Rivers Park carefully build on existing assets and create new, meaningful and imaginative ways of adding to the well recognised and loved quality of the Pittsburgh's night time panorama.

The fundamental aim of any lighting strategy is to ensure that successful public realm spaces that are attractive by day remain safe, comfortable and engaging after dark. The strategy acknowledges that peoples reaction's to night time public realm spaces are centred on a sense of well being resulting from a complex amalgam of factors such as:

- Visual comfort
- Sense of place
- Spatial legibility
- Way finding
- Personal safety
- Psychologically comfortable balance between lit and unlit
- Sense of wonder and excitement

Lighting Strategy for the Three Rivers Park is as much about the unique qualities of the park and Pittsburgh as it is anticipatory and people based.



A1 Allegheny panoramic vista A2 Monongahela panoramic vista A3 Ohio panoramic vista
 B Creating a distinct nighttime identity for Three Rivers park through a bold use of green light to brand/demarcate the location of the park
 C Creating an extended scenic setting

Three Rivers Park as an integral part of the bigger night time panorama of Pittsburgh.

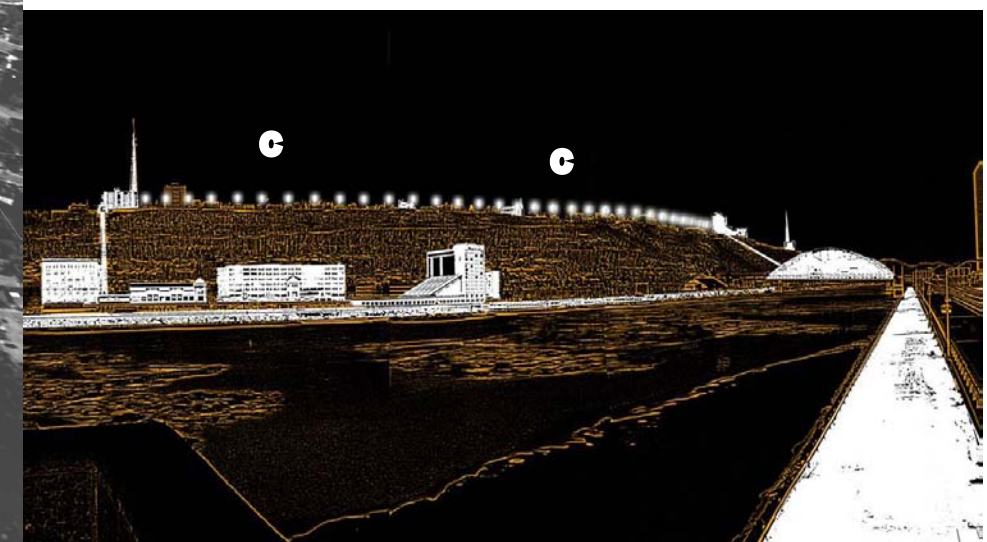
The lighting of the Three Rivers Park needs to establish a clear relationship to the landscape/urban context of Pittsburgh.

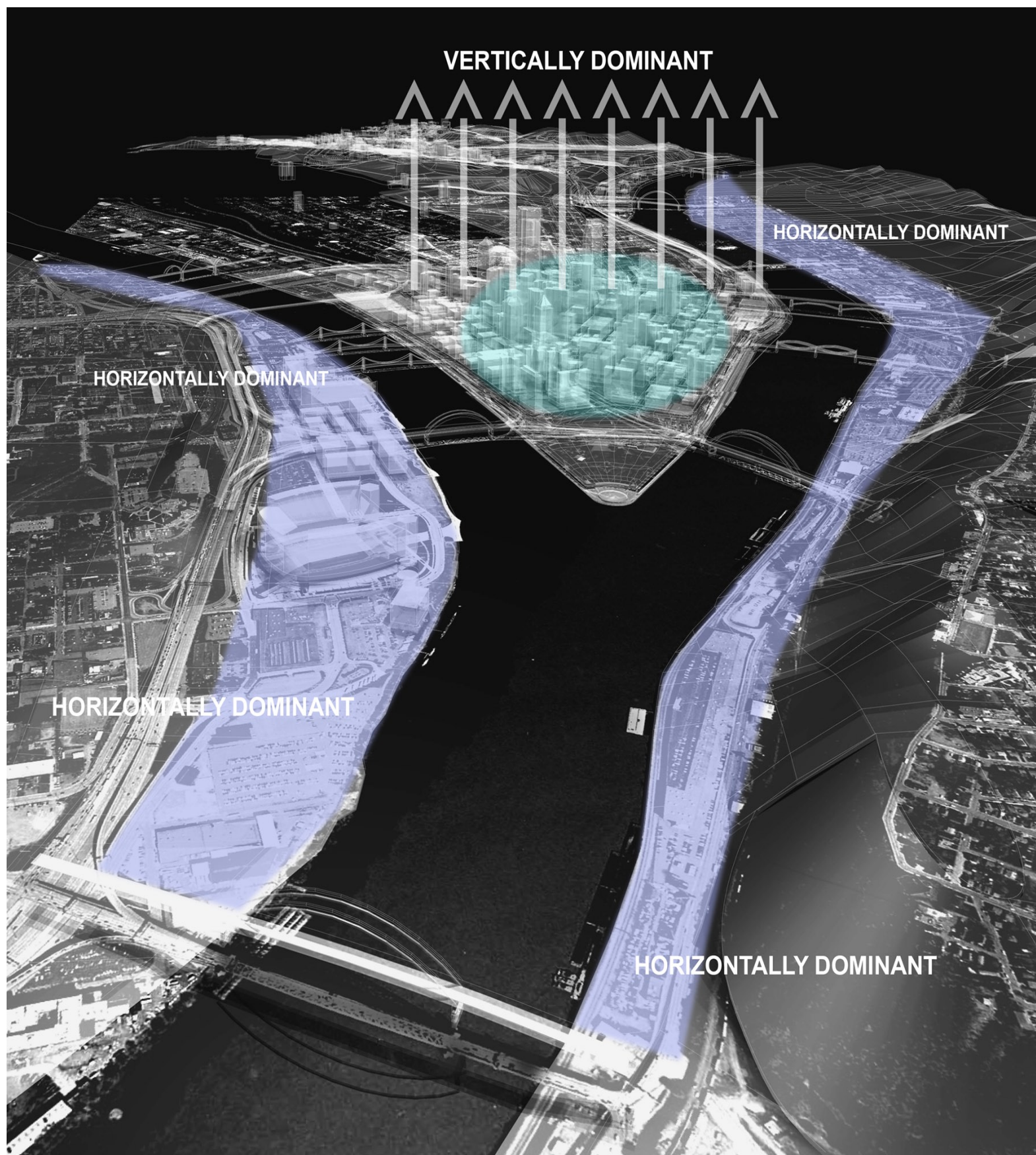
The three differing panoramic vistas along the Allegheny (A1) , Monongahela (A2) and Ohio (A3) rivers needs to be developed into a world class night time panorama - as a visually rewarding journey of discovery for people using the riverbanks and the rivers.

The unique nature of the Three Rivers Park as a public realm formed by land and water needs to be celebrated and made legible by an imaginative use of lighting- for example by using light as a means of branding the green quality of the destination. (B)

The residential rim of Mount Washington and Grandview Avenue needs to be brought into the nighttime panorama of the Three Rivers Park to emphasise its scenic setting. (C)

The computer model of Pittsburgh used in the Urban Principles illustrations provided courtesy of Burt Hill Kosar Associates Inc.





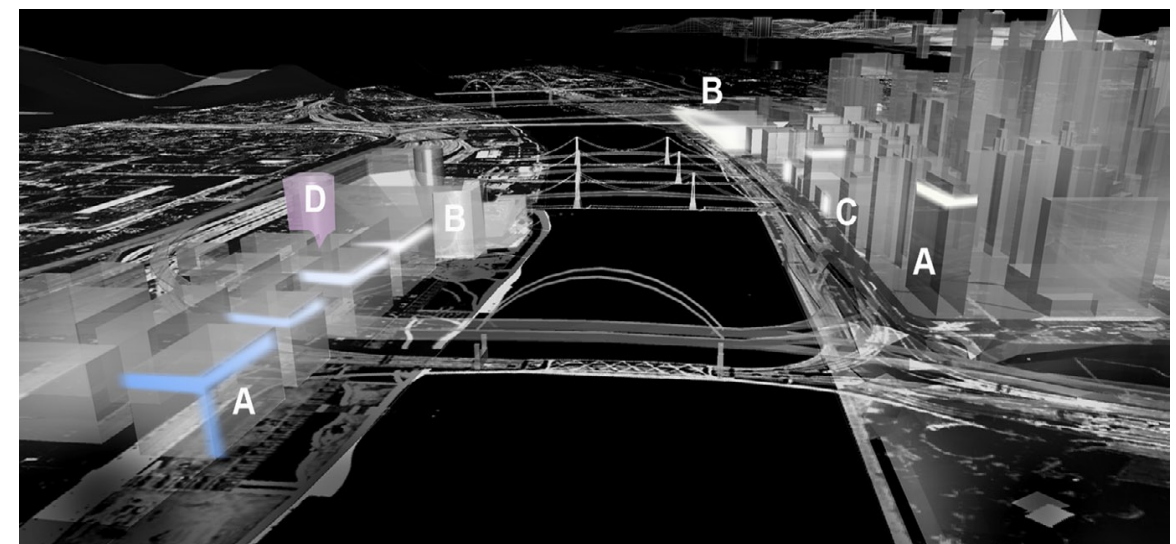
Creating a framework

The architectural lighting designs in the Three Rivers Park area need to respond to and compliment the strong verticality of the down town high rise buildings. The architectural envelope of the park with its predominately horizontal massing when lit needs to create a strong physical framework for the more intimate lighting of the water edge circulation spaces.

The objectives of illuminating selected buildings on the water front rim are:

- Reveal and enhance the night time character and identity of Three Rivers Park
- Reveal and enhance the appearance of individual buildings at night.
- Assist in orientation and wayfinding.
- To reinforce a sense of place.
- As part of an important long view or panorama.

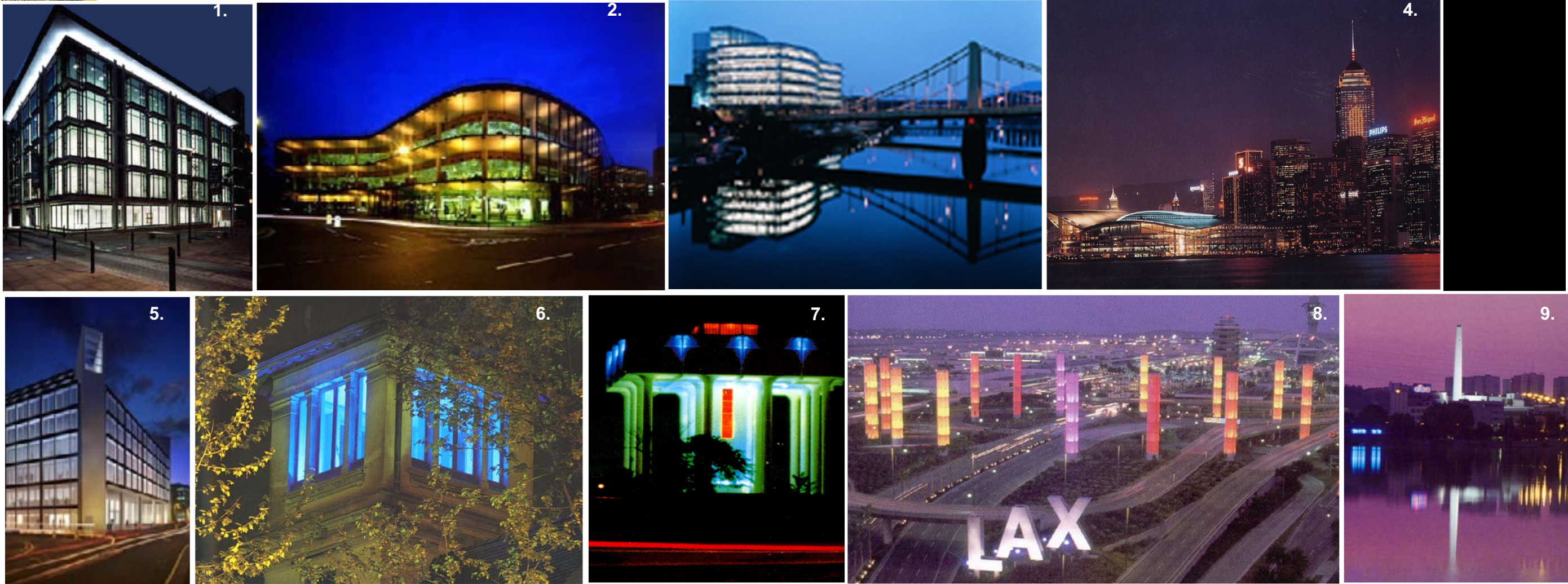
Within this framework a balanced overall effect needs to be created through the application of a hierarchy of lighting approaches in response to the building's architectural merit, function and type of materials used in the construction of the facade.



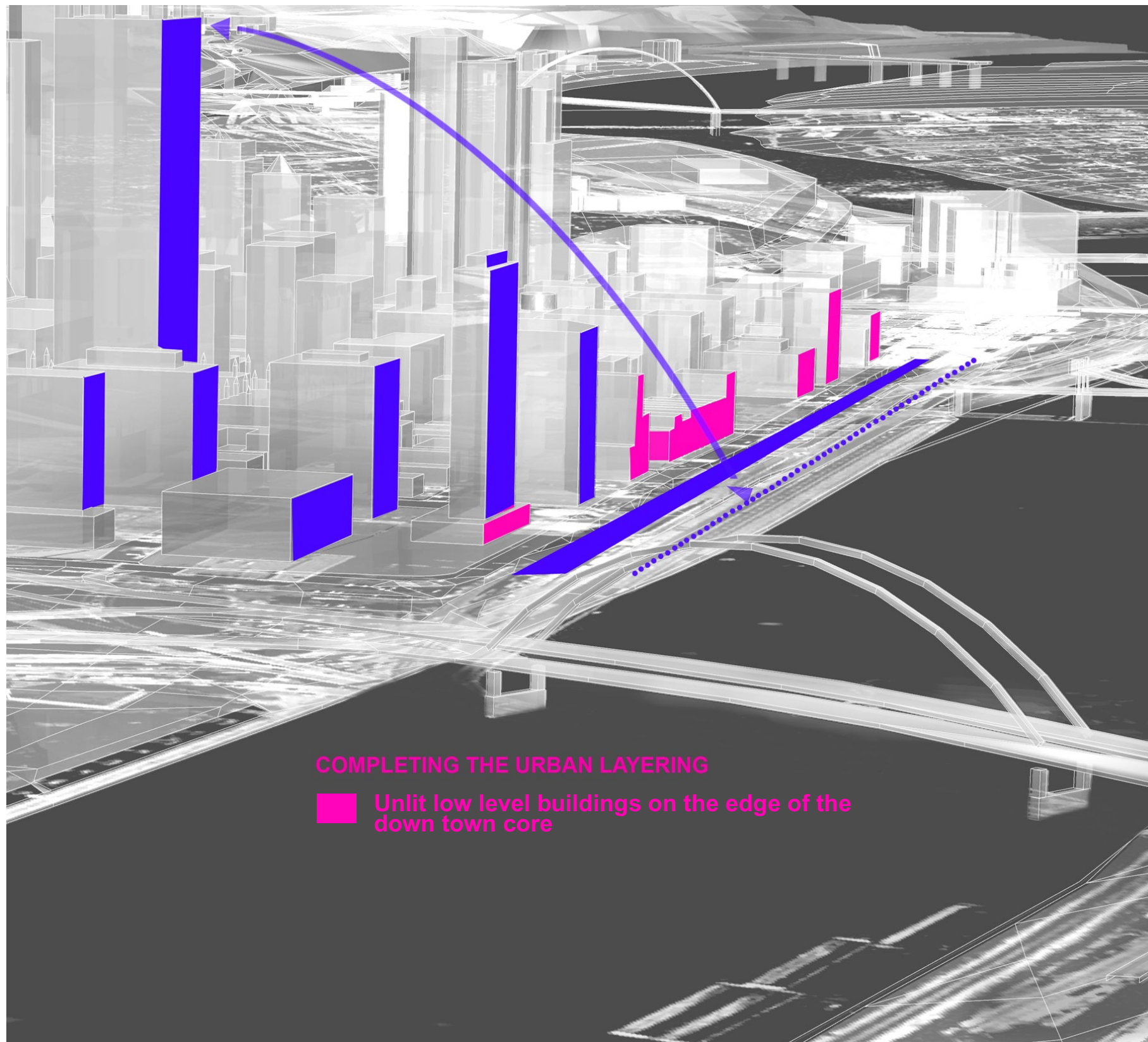
- A buildings illuminated with selective facade lighting and a strongly emphasised roof line
- B Landmark buildings i.e. Convention Centre, Alcoa Headquarters Contemporary structures and their facades formed from highly transparent and reflective materials respond well to internal illumination that reveals the inside structure of the building.
- C Buildings only partially lit, emphasising architectural detailing Using lighting to emphasise distinct architectural details of individual buildings as part of an overall composition is often more effective then illuminating the whole facade.
- D Buildings and structures lit as destination landmarks Buildings such as multi-storey car parks, elevated highways, industrial chimneys, communication masts can all be effectively lit to signal Three Rivers Park as a destination



Creating a physical framework - Illustrations of the principal lighting approaches



- | | | |
|----|--------|--|
| 1. | Type A | Office block with illuminated roof line parapet |
| 2. | Type B | Dumas Building, London - an example of how the final lighting effect of a glass fenestration building can be controlled in intensity |
| 3. | Type B | ALCOA Building Pittsburgh |
| 4. | Type B | Hong Kong Convention Centre - the golden color of the raised roof contrasts well with blue uplighting of the underside of the roof |
| 5. | Type C | Office block with a only partially lit facade at pedestrian level |
| 6. | Type C | Lyon, France- building balcony lit with blue light forming a gateway aspect |
| 7. | Type D | Water tower in Glasgow, Scotland |
| 8. | Type D | Los Angeles International airport entrance |
| 9. | Type D | Illuminated chimney in Lyon, France |



Completing the urban layering

Pittsburgh contains many fine examples of lit historic and contemporary architecture in its downtown core. However very few of the lower buildings particularly on the river edge are lit. These buildings, although of frequently high quality, recede into comparative darkness at night and are rendered invisible. When selectively lit and seen from the water edge these lower scale buildings will greatly enhance the setting of the Three Rivers Park.

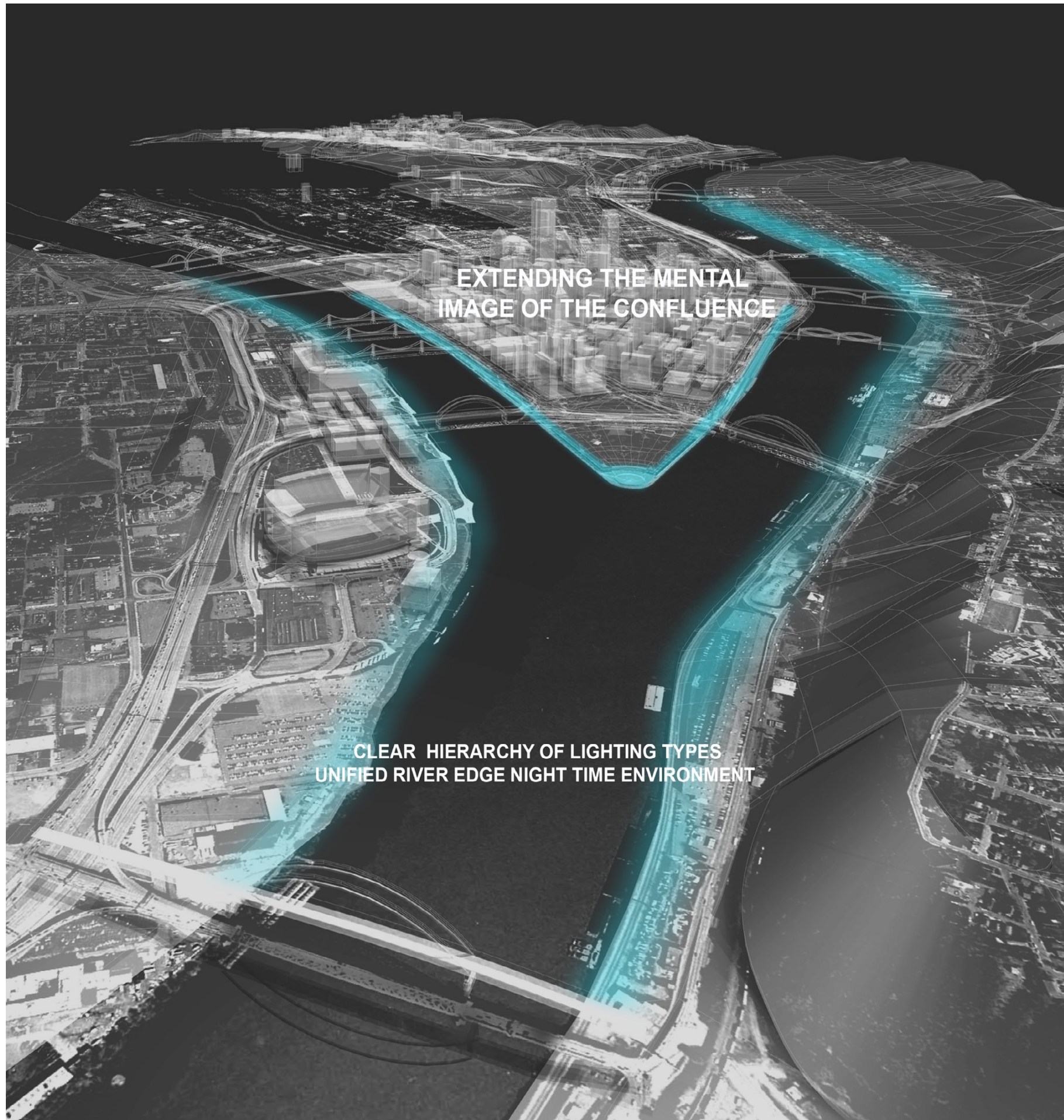


The dark architectural river rim opposite Mon Wharf

The combined nighttime panorama

The creation of a harmonious city wide nighttime panorama needs to take into account how lighting of the downtown highrise core and of Three Rivers Park will effect each other.

A lighting strategy for high-rise buildings needs to be developed to examine the impact of the architectural lighting and corporate branding of high rise buildings on Three Rivers Park. Equally, a regulatory framework for electronic media within the Three Rivers Park and on its fringes should be developed to provide clear urban/zoning as well as management and content programming guidance.



Building a coherently lit nighttime environment

A cityscape at night does present different requirements and challenges. The night time realm of the Three Rivers Park needs to become a vibrant, positive and definable environment with clear connections in the surrounding city fabric.

Three Rivers Park will become the public realm heart of the day and night time downtown adorned with a necklace of destination spaces, connective river edge trails, temporary public and green recreational spaces.

The individual beads of this necklace need to be connected by a clear luminous thread marking the main movement arteries of the park as well as the main circulation loop.

As recommended in the Lighting Design typology section the luminaire types on the riverfront and throughout the Three Rivers Park should be rationalised and a distinct family of luminaires should be installed throughout the park.

As this will take time to implement a visual coherence needs to be achieved initially through a change towards white light. The practical advantage of this approach is that it can be implemented both in new lighting as well as carried out by retrofitting many of the existing luminaires.

Using white light as the recommended light source will create:

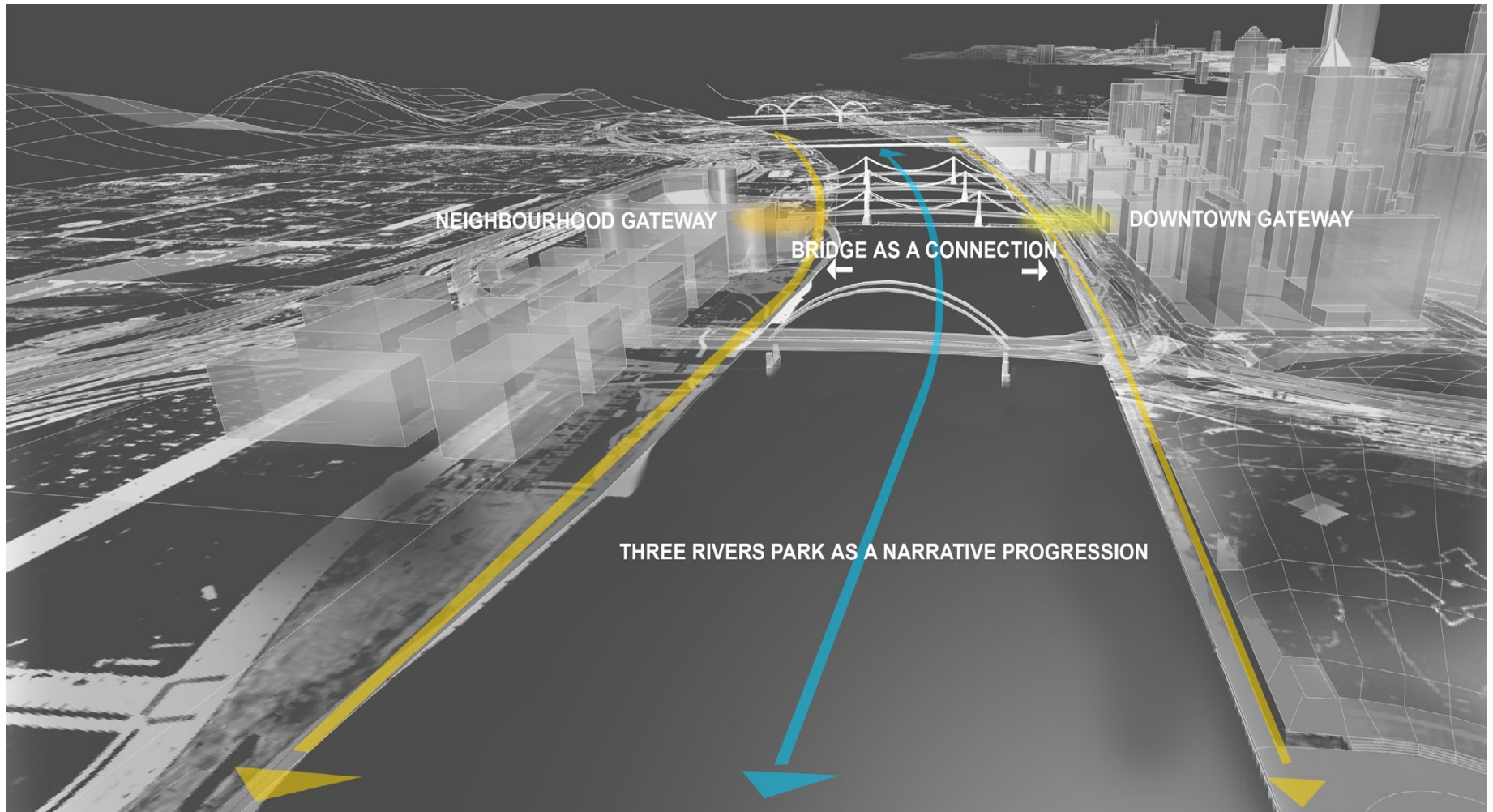
A distinct night time river edge - drawing people to the experience of the confluence from Point State Park

A psychologically more inviting and safer night time environment

The white lit river edge will also extend the experience of the confluence in people's minds throughout the Three Rivers Park as well as unify the North and South shore circulation routes.



Examples of white light application on pedestrian routes



Three Rivers Park as a night time narrative progression

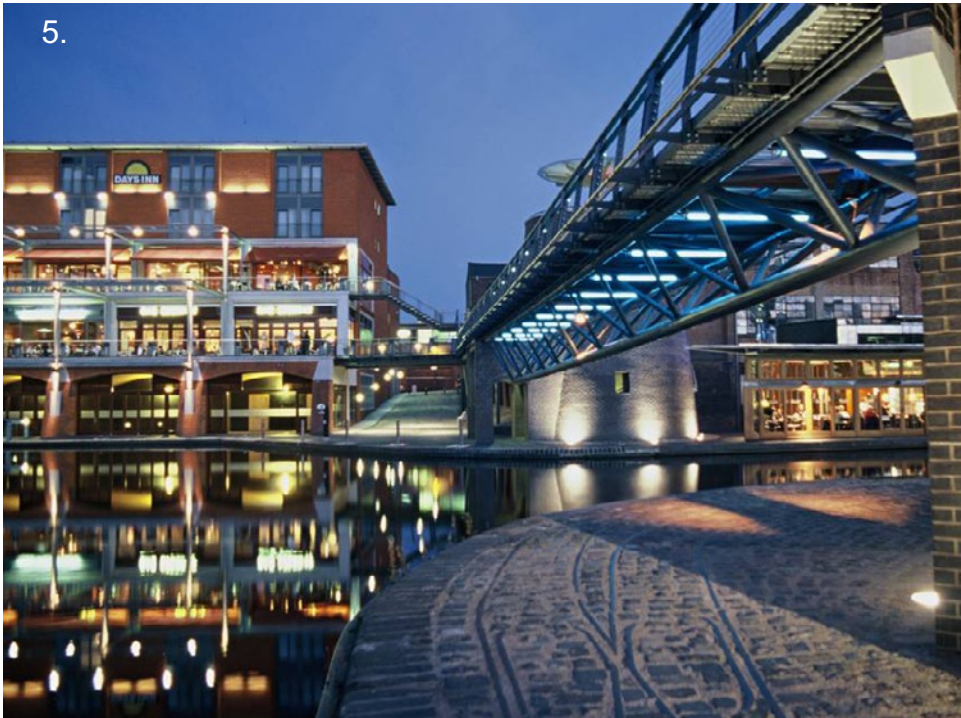
Where reference points are scarce or difficult to identify, night lighting can help. It can add emphasis and/or transform an apparently unwitting space or building into a effective marker to walk to or travel to by boat. Within the Three Rivers Park lighting in addition to creating a consistently lit environment must also address the psychology of narrative progression to ensure that people feel comfortable moving through the park by being able to clearly identify the next destination space as well as the next exit/entry points from the river edge walkways.

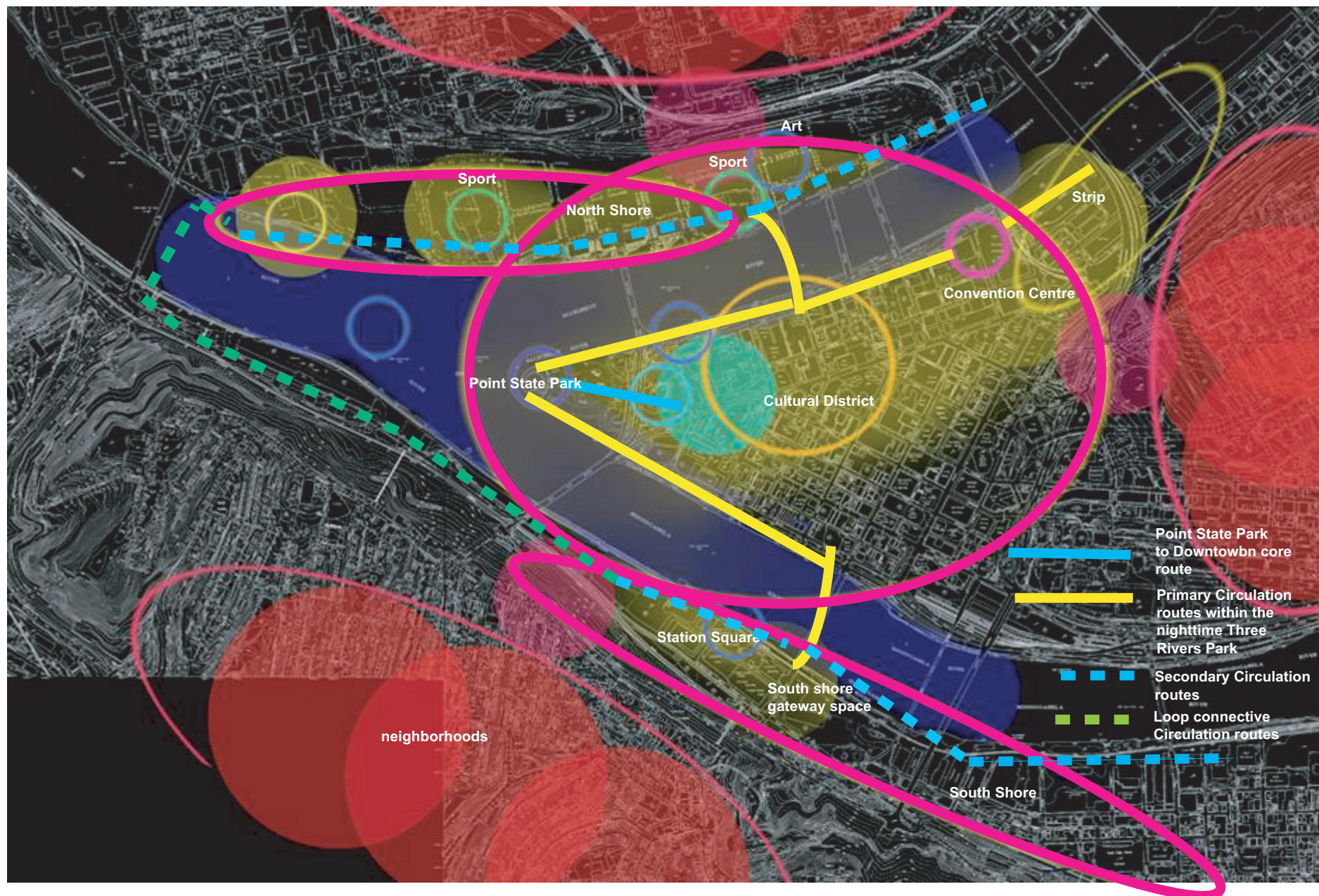
Currently most of the undersides of the bridges represent unpleasant pinch points, which have considerable negative effect on the pedestrian experience. These type of spaces could benefit from the application of creative lighting producing, for example, an open air gallery of temporary lighting installations.

Gateway night time spaces need to be created at points where people decide on entering the river edge walkways. The character of these spaces will play an important role in reassuring people that walking on the river edge is a viable alternative to the pavements of adjoining roads, taking a taxi or using the car, subway or bus.



1. + 2. Creating a gateway space with a sculptural canopy and lighting Whitehaven waterfront UK
3. Light gateway markers London
4. Transforming the underside of a bridge with an art installation Seile river France
5. Lighting the underside of a bridge





Pedestrian routes and the night time economy of downtown

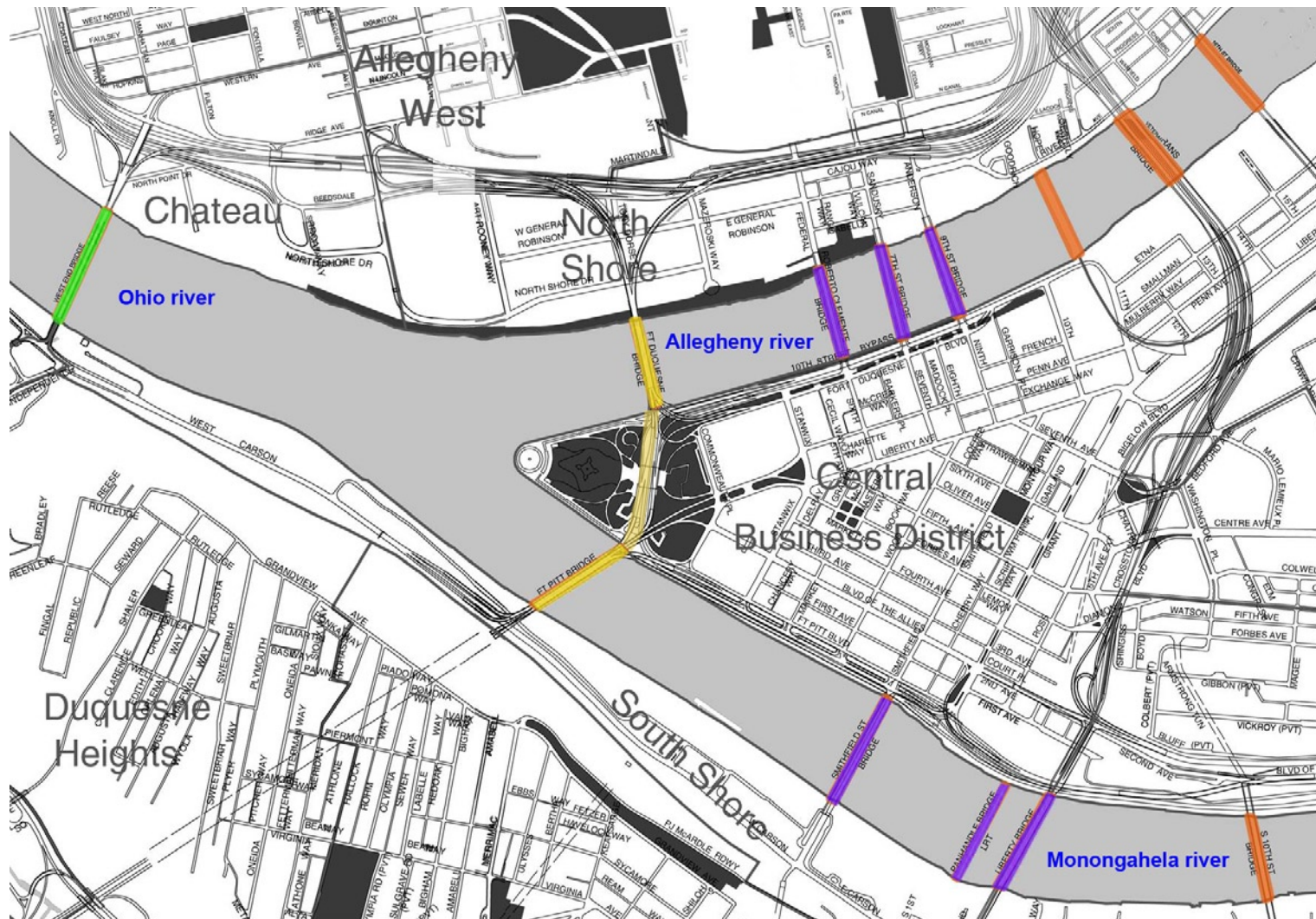
The day time economy of Pittsburgh's downtown manifests an incompatibility seen at the regional level between a declining population and continuous expansion of retail space.

The managed decline of the day time retail economy in downtown is reflected by an underperforming night time economy. As a result of this now widely recognised situation a number of initiatives involving the downtown are under consideration and development. Some of these initiatives, such as the provision of residential units in the heart of the area, will have a noticeable impact on the night time economy and the related social functioning of the downtown. However, potentially the biggest impact in the near future on the downtown's night time economy will be the full synergic impact of its main economic and social drivers, the cultural district activities, the two sports arenas and most significantly the new Convention Centre.

In this context the Three Rivers Park as a night time connective public realm space is a significant catalyst through which the North and South shores and the regenerated Strip can be integrated into the context of night time economy of an expanded downtown core.

For the Three Rivers Park to successfully fulfil this function it is essential that the lighting designs for the primary and secondary circulation routes provide an environment which is lit to a consistent standard. The legibility and continuity of the lighting on these routes will create a clear way finding environment leading to an increase in the walking radius that people feel comfortable during nighttime. The practical effect of this will be a greatly increased footfall, for example, by Convention Centre delegates, through the expanded downtown core. The night time economy will correspondingly benefit from increased size, accessibility and diversity of choice.

These changes will open the possibility of marketing and promoting Pittsburgh's downtown as a regional and international night time destination with the Three Rivers Park and its waterfront developments as its integral part.



- Bridge as a Gateway Landmark
- Bridges as a Highway structures
- Core City Bridges
- City Bridges

Bridges in Three Rivers Park

The night time appearance of the bridges of Pittsburgh is of vital symbolic importance to the overall character and quality of the night time environment of Three Rivers Park. In addition to their strong urban presence, many of the bridges represent an important link to Pittsburgh's industrial past.

Pittsburgh's historic bridges were not built as engineering structures for their own sake; they are a means of crossing rivers and linking communities. The lighting of bridges needs to focus on emphasizing their urban function within the public realm of the park. The bridge lighting has the potential to become a powerful unifying presence drawing together water and land as the essence of Three Rivers Park. The lighting vocabulary needs to focus on emphasizing the horizontal connectivity by, illuminating the horizontal deck while using the reflectivity in the water to enhance the sense of visual connection.

The combined effect of the serial progression and close proximity of the bridges will need to be considered when developing individual bridge lighting design concepts. To ensure a coherent visual experience from the rivers and the shorelines the engineering / architectural difference in the individual bridge structures needs to

be emphasized while establishing cumulative compositional views for the greatest impact.

The bridges within the Three Rivers Park lighting strategy form three distinct urban groups:

1. Bridge as a Gateway Landmark - West End bridge with its dramatic arch clearly visible from Point State Park and the western reaches of the North and South shorelines is a scenic gateway landmark. The lighting design for this bridge needs to clearly address the scale of the structure and its urban function as a visual termination point for Three Rivers Park as well as a gateway beyond.

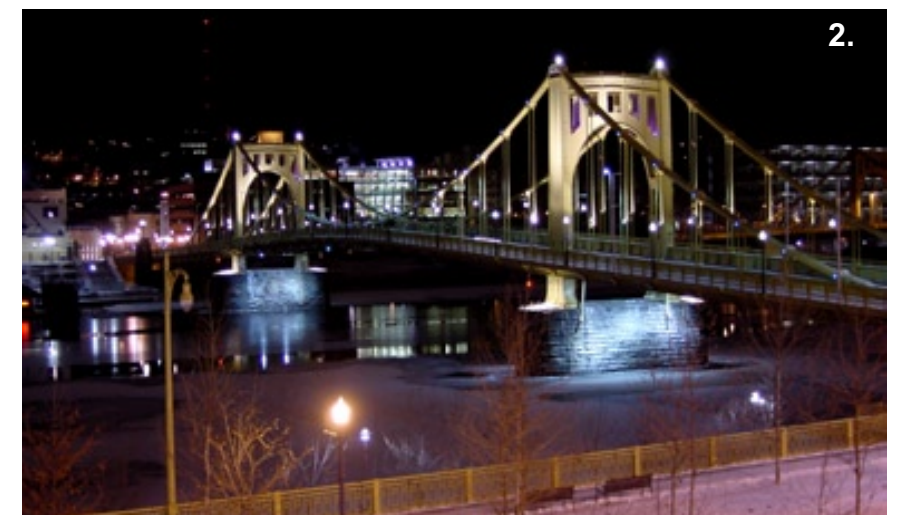


West End bridge

2. Bridges as Highway structures - Ft. Duquesne and Ft. Pitt bridges, large scale highway structures in a prominent location will need visually sensitive lighting. The lighting design for these bridges needs to focus on the ribbon-like effect of these structures without emphasizing the height and massing of the structural arches that carry the highway decks. The lighting of these arches would visually unbalance the combined nighttime composition of Point State Park and of the down town core. (Illustration 1) The ribbon effect of the bridge lighting in this urban location needs to extend to also include the central elevated highway sections in Point State Park.



3. Core City Bridges - Roberto Clemente Bridge, 7th and 9th street bridges on the Allegheny river Smithfield Bridge, Panhandle Bridge and Liberty Bridge on the Monongahela river The lighting designs for these bridges need to respond coherently to the existing lighting schemes (illustration 2) and develop a new additional layer of lighting focused on a overall theme such as 'Pittsburgh the city of Golden Bridges' or on celebrating the individual identity of the rivers.



Roberto Clemente bridge illumination

4. City Bridges - Fort Wayne Railroad Bridge, Veterans Bridge and the 16th street Bridge on the Allegheny river South 10th street Bridge on the Monongahela river The lighting designs for these bridges need to further develop the overall lighting theme as well as provide a transition into the unlit river environment.



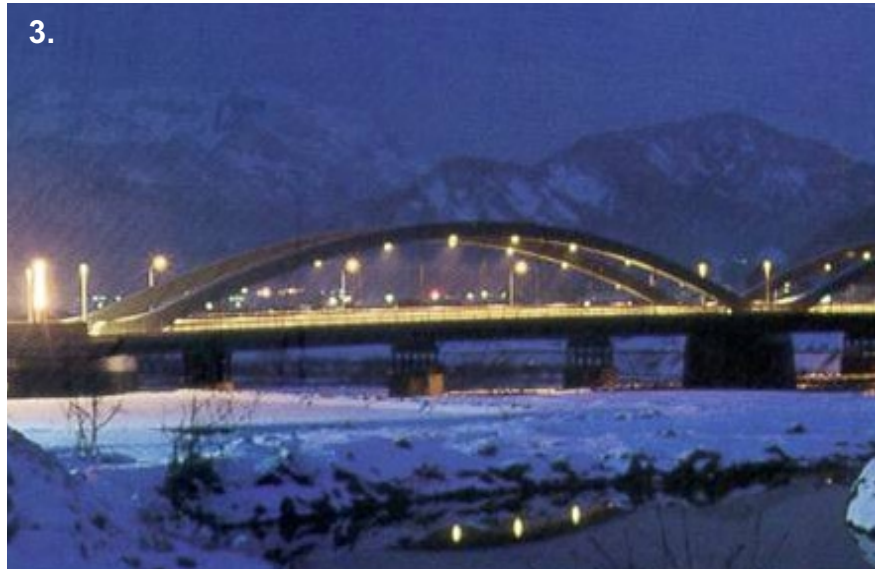
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Illustrations of relevant examples:

- | | |
|------------------------|-----------------------------|
| 1. Gateway Landmark | Sydney Harbour bridge |
| 2. Bridge as a highway | Washington Bridge, Florida |
| 3. Bridge as a highway | Katsuyama Bridge, Singapore |
| 4. City Bridge | Lyon, France |
| 5. City Bridge | Chelsea Bridge, London |



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Darkness and light

The environment of Three Rivers Park is experienced by people directly along its main panoramic vistas from boats on the individual rivers or within the confluence, from bridges or river walkways. The optical qualities of the rivers, the sky and of the land edges form a complex environment requiring a good overall nighttime vision. As the nighttime vision can be easily diminished by exposure to strongly contrasting levels of illumination the quality of people's experience of the water and land aspects of Three Rivers Park is dependent on a close attention to the balance between darkness and light.

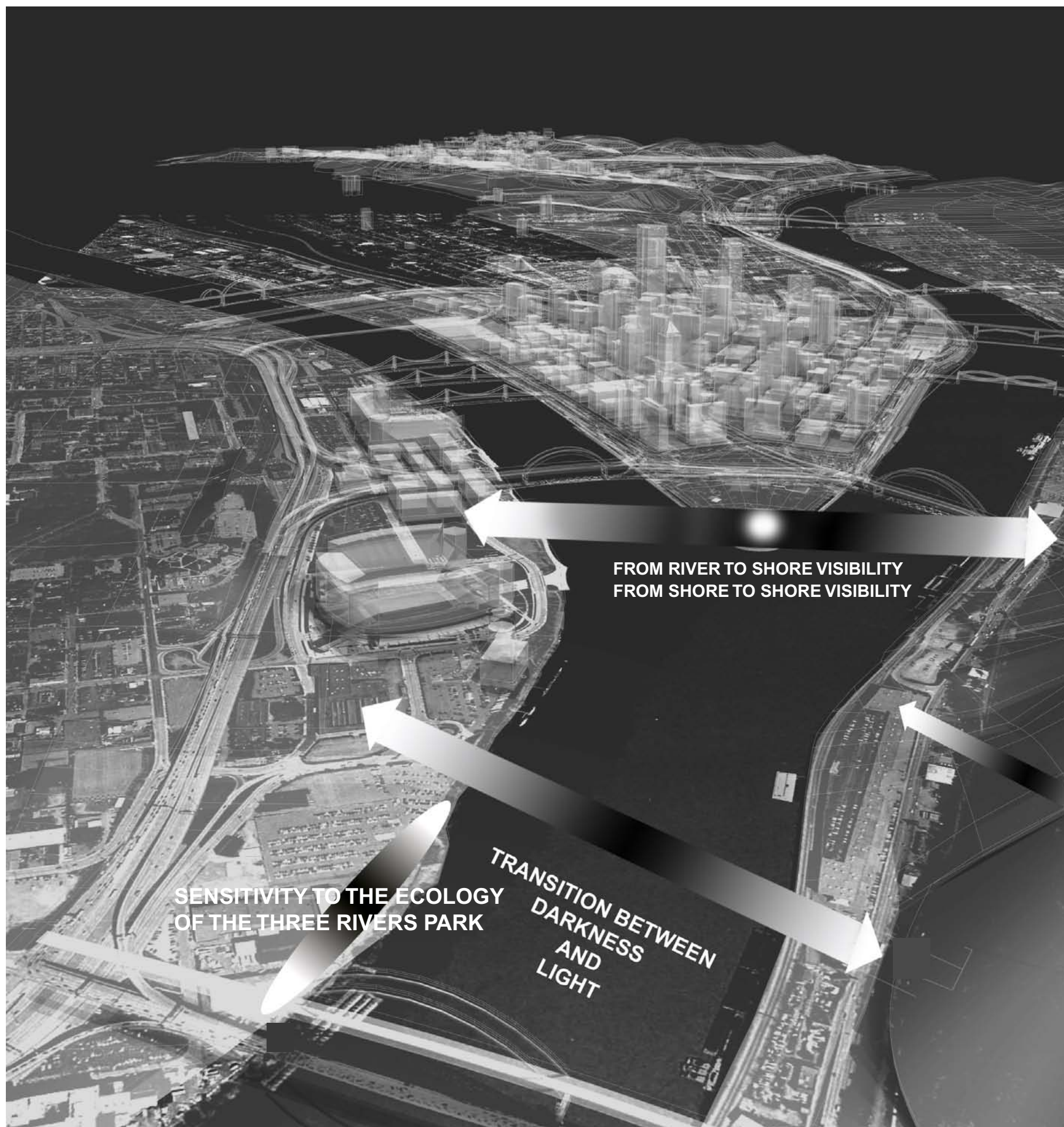
The detailed lighting designs need to establish :

- a clear readability of the surface of the rivers from the shorelines
As night approaches the surface of the river still reflects the residual sunlight whilst the banks are beginning to recede into darkness. During nighttime the rivers act as mirror surfaces reflecting the lights of the surrounding city as well as the dark sky. The mirror like quality of the surface is affected by water currents, differing levels of transparency and depth of water and by seasonal flow variations from floods to ice.
To be able to fully appreciate this people on the shorelines need be able to see and distinguish the variations of the river surface whilst being able to clearly identify the transition between land and water.



Clearly lit river edge without glare affecting the nighttime vision of river users

- a clear readability of the shorelines from the rivers
As the navigable sections of the rivers are predominantly in darkness the nighttime vision of people on boats can be easily diminished by single over lit shoreline environments. Once the nighttime vision is diminished the readability of the shoreline is lost for aduration of time.
- a shore to shore visibility across the rivers





St. James Park London - an example of how, in the centre of a busy city, a sensitive balance between darkness and light can be created reflecting the needs of man, animals and plants.

Recent studies have conclusively demonstrated that vertically emitted light from illuminated ground plane is the strongest contributor to pollution of the night sky. This radically alters the basis of limiting the pollution of the night sky by controlling predominantly only the oblique or vertical luminous flux. Consequently it is the lighting of horizontal planes in Three Rivers Park - the trails and highways that needs to be carefully considered.

Sensitivity to ecology

The lighting designs for Three Rivers park must be a holistic response to both needs of people and needs of plants and animals. The effect of any development project on the natural environment can be particularly complex and sometimes the range of indirect impacts can be considerable.

Within Three Rivers park lighting designers need to consider the likely impact of artificial lighting in what was a previously dark area or landscape. This should define the likely range and extent of such impacts, both during construction and operational life of the lighting installation.

A significant amount of animal species and plants are sensitive to artificial light. Its insensitive use might for example shorten the flowering period of some plants or modify the nocturnal behaviour of some animals.

Renewable Energy

Alternative energy sources such as wind power and photovoltaic panels should be used in areas where for example the Ohio and Monongahela river trails connect to open landscape. Renewable energy sources can provide a viable alternative to lighting systems based on cabled main electricity supply. The luminous trail marking in these areas will use low energy consumption luminaires lit only for limited periods after nightfall.



The striking presence and panoramic day and night views of Three Rivers Park represent a potential means of adding substantial economic value to Pittsburgh's riverfront developments. It is therefore important that the task of making Pittsburgh into one of North America's best lit cities, with Three Rivers Park as its crown jewel is approached in a long term, holistic way.

Future good practice should be based on a shared acceptance of the broad lighting principles and hierarchy of lighting types contained within the lighting strategy. A key theme of the project has been the making of connections and encouraging pedestrian use of the trails. As Three Rivers Park is developed, the following lighting concepts will help create unique night time panoramas for the river front. A clear and legible lighting hierarchy will clearly define the trail even when the local environment changes along the route.

The lighting should consist of a number of distinct layers:

- Lighting for pedestrian safety and security,
- Landscape lighting,
- Lighting integrated into the design of benches and street furniture
- Building façade lighting (where appropriate)

Color and Quality Of Light

The color and quality of artificial light are elements that can be utilised to create a common thread linking all areas of Three Rivers Park.

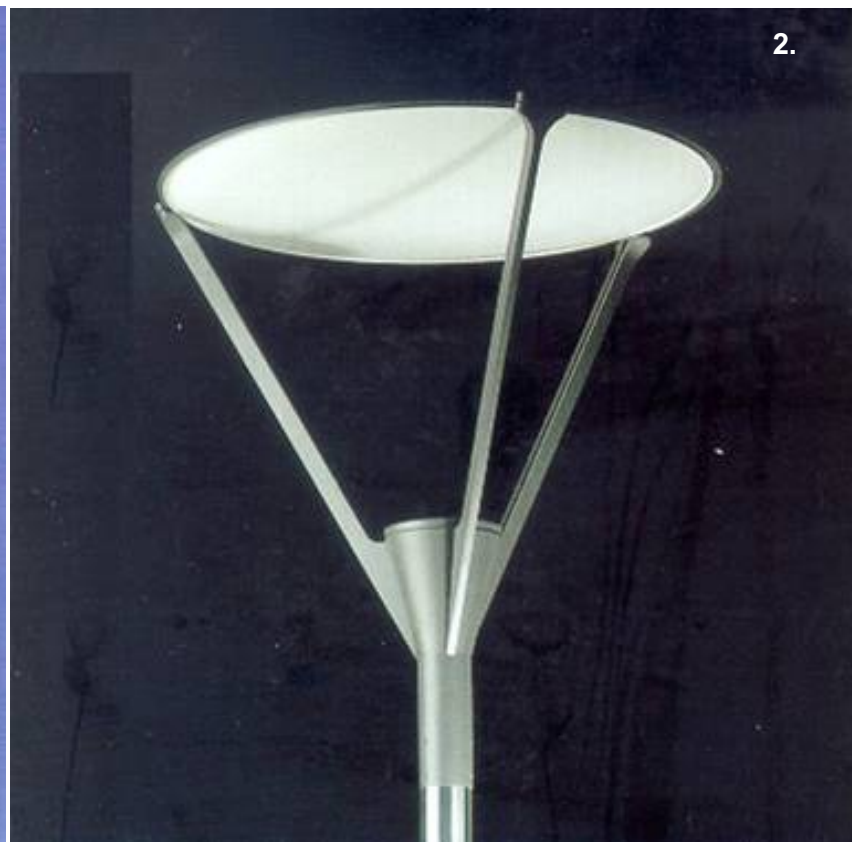
The trails and footpaths should be lit with white light. Good color rendering warm white 3,000K ceramic metal halide lighting is recommended. This will differentiate the trails in the park from the surrounding areas of the city, which are predominantly lit with high-pressure sodium lighting.

Ceramic metal halide lamps have a high efficacy and a high color rendering index. They are physically more compact than high-pressure sodium lamps and can be placed in an optimum relationship to the surrounding reflector optic, to maximise luminaire efficiency and minimise glare.

The optical characteristics of the luminaires, levels of illuminance and general light distribution should be similar throughout the trails, to create a uniform overall ambience at night.



Examples of white metal halide lighting with good uniformity



Possible luminaire types

- 1.2. Pole Top Luminaire for the trail
- 3. Cut-Off Lantern for Roads

Luminaire Design

In many areas of the riverfront there is currently an uncoordinated mix of different luminaire types with different appearances and functions that lend a confused appearance to the overall night scene.

The luminaire types utilised on the riverfront and throughout Three Rivers Park should be rationalised. A family of luminaires should be selected that will define the character and image of the trail, both in terms of the way in which the spaces are illuminated at night and in terms of a clearly expressed hierarchy of luminaire styles and functions.

A neutral but contemporary style of luminaire design is suggested for the Three Rivers family of luminaires. As a short-term solution, the possibility of adapting existing luminaires to accommodate 3,000K warm white ceramic metal halide sources could be investigated.

Pole Top Luminaires for the Trail:

A unique pedestrian-scale pole-top luminaire should be utilised in all pedestrian areas of the trail. The design of the luminaire will then be clearly identified with the park to assist in wayfinding, both during the day and at night and to create a unified lighting appearance after dark.

The pedestrian-scale luminaire should be optically efficient, avoiding discomfort glare. It is also important that the luminaire is legible from distant views to clearly define the trail and act as a visual icon.

The height of the luminaires and the spacing between the columns should be determined by the optical characteristics of the actual luminaire selected. Maximum and Minimum levels of illuminance should be in accordance with Illuminating Engineering Society of North America IESNA recommendations.

Cut-Off Lanterns for Roads

In areas such as the 10th Street Bypass, where the pedestrian trail is located adjacent to roads, the general street lighting should be rationalised and upgraded utilising 3,000K warm white ceramic metal halide light sources. This will reinforce the white light metal halide pedestrian-scale lighting proposed for the trail itself.

Hard & Soft Landscape Lighting:

Selective landscape lighting should be applied throughout the trail. With careful planning, a sequence of views and vistas can be revealed that will lead people along the trail, from one point of interest to another.

Where possible, supplementary lighting should be integrated with the design of architectural elements, structures and street furniture. Discreet low level lighting can be incorporated into public seating, steps, walls, handrails and other changes in grade level.



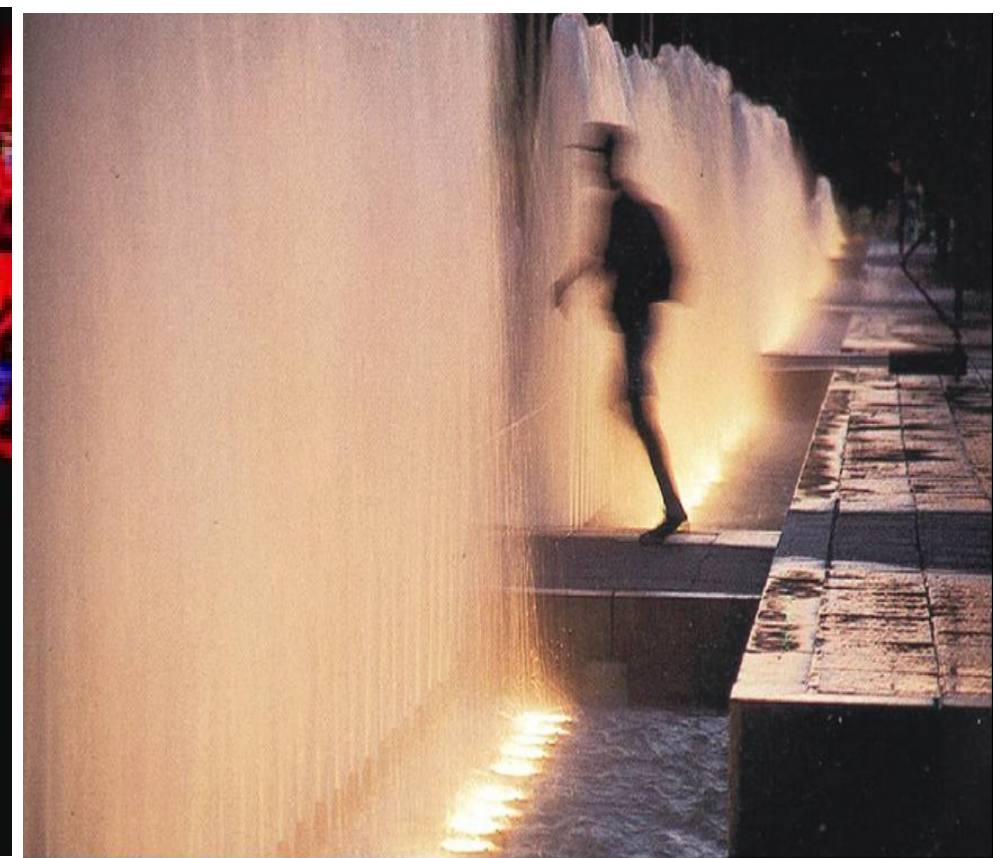
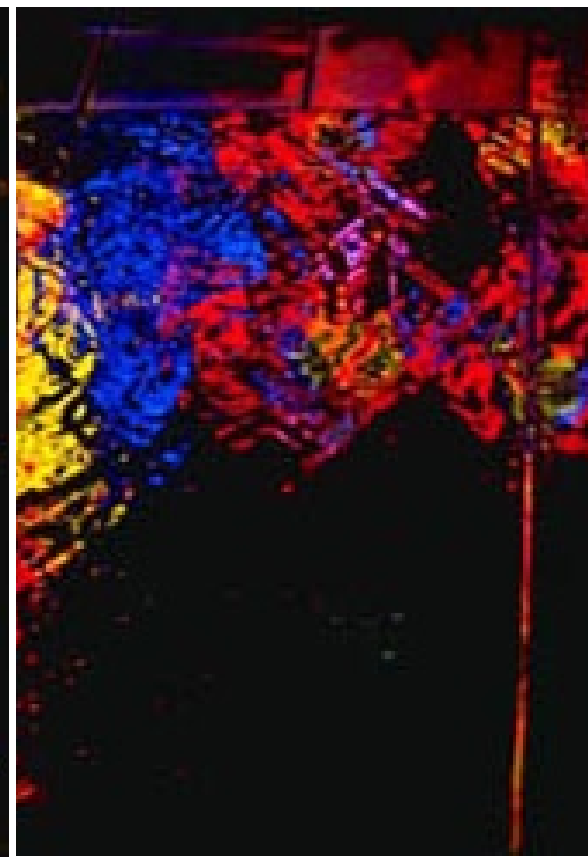
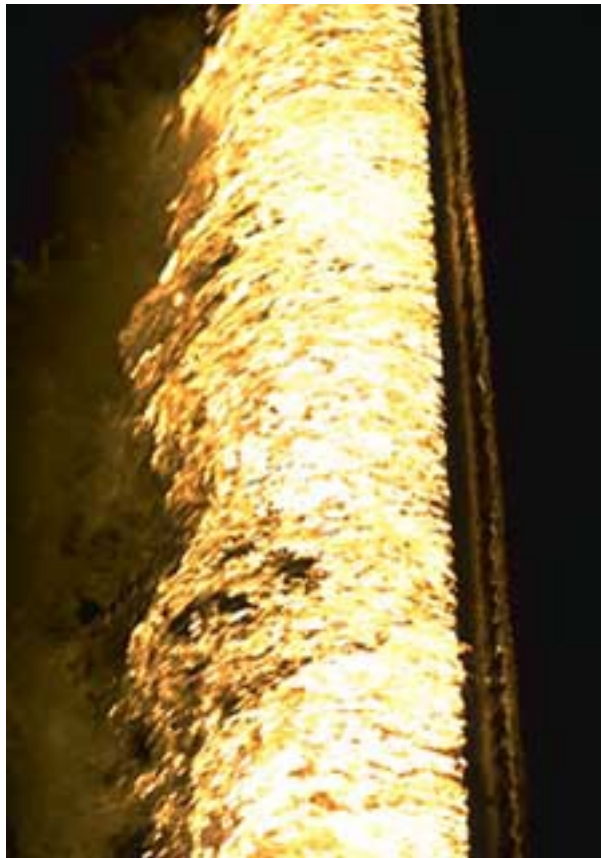
Technical Standards

It is recommended that all light sources utilized in the future should be color constant 3,000K ceramic metal halide types.

Care should be taken to avoid disability glare (veiling luminance) caused by stray light scattered within the eye that reduces the contrast of the primary image on the retina. Direct views of all artificial light sources within the trails should be avoided. Optically efficient luminaires with appropriate louvres and light baffles should be utilised.

Maximum and Minimum levels of illuminance should generally be in accordance with Illuminating Engineering Society of North America (IESNA) recommendations.

| Recommended Maintained Illuminance Levels for Pedestrian Ways (taken from IESNA Design Guide DG-5-94: @Recommended Lighting for Walkways and Class 1 Bikeways) | | |
|---|---|--|
| Walkway & Bikeway Classification | Minimum Average Horizontal Illuminance Levels on pavement* (lux/footcandles) | Average Vertical Illuminance Levels for Special Pedestrian Security** (lux/footcandles) |
| Sidewalks (Roadside) & Type A Bikeways | | |
| Commercial Areas | 10 / 1 | 20 / 2 |
| Intermediate Areas | 5 / 0.5 | 10 / 1 |
| Residential Areas | 2 / 0.2 | 5 / 0.5 |
| Walkways distant from Roadside & Type B Bikeways | | |
| Walkways & Bikeways | 5 / 0.5 | 5 / 0.5 |
| Pedestrian Stairways | 5 / 0.5 | 10 / 1 |
| Pedestrian Tunnels | 20 / 2 | 55 / 0.5 |
| * Uniformity ratios should not be greater than 10:1 maximum to minimum | | |
| ** For pedestrian identification at a distance. Values are specified at 1.8 meters (6 feet) above the walkway. Scotopically rich light should be used. | | |



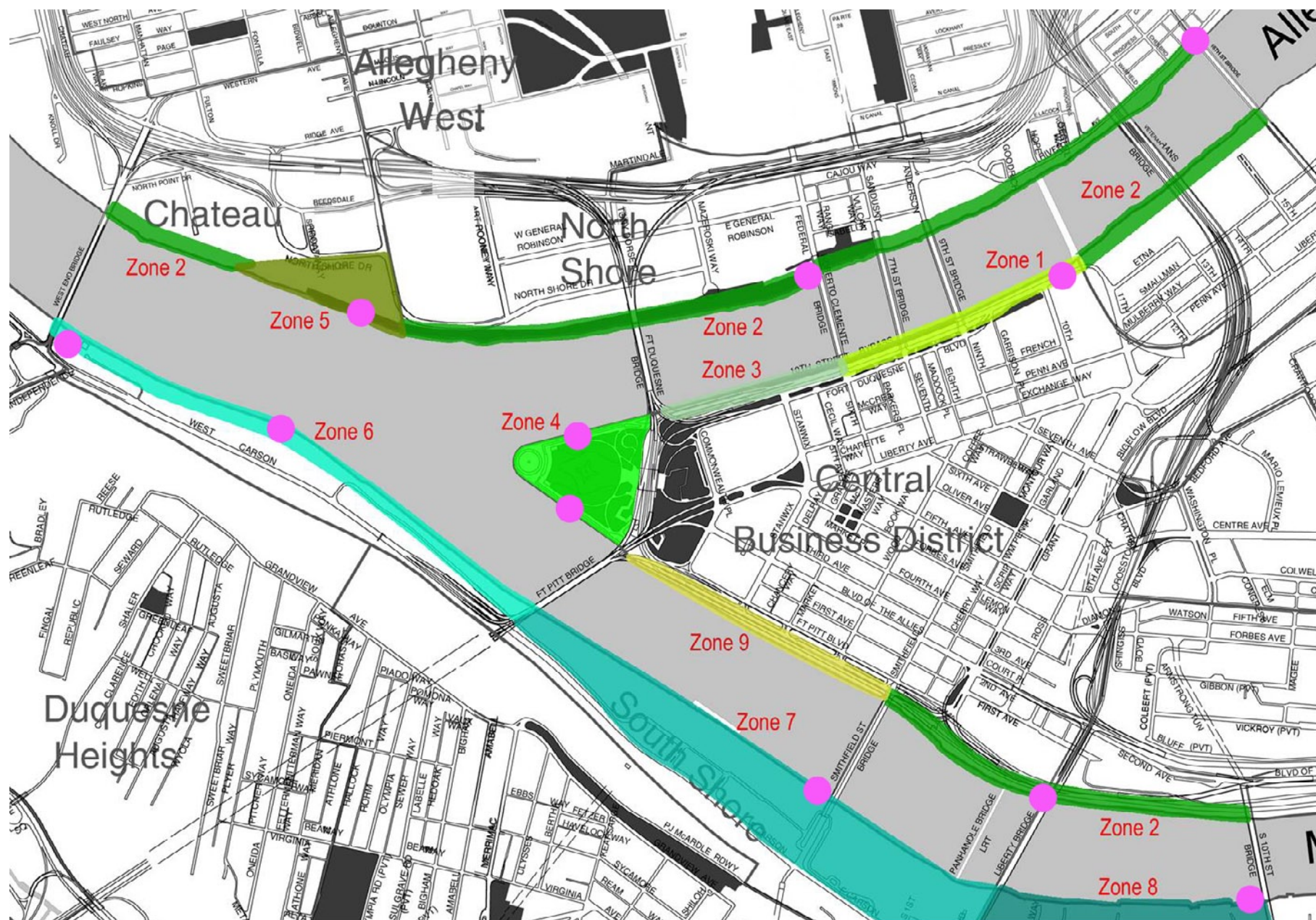
1. Lighting Water

Within Three Rivers Park many possibilities exist of creative lighting of water starting with the monumental fountain in Point State Park to lighting the surface of the rivers in selected locations. Today modern lighting technologies and programatic control protocols allow the creation of spectacular lighting fountain displays without excessive complexity a cost. Sucesfull fountain illumination needs to explore fully waters capacity conduct both natural and artificial light with the varied character of the water display from straigh or curved jets to soft mist acting as a ever changing display canvas. The actual water body from which the fountain emerges should be illuminated by submerged lights to further heighten the final effect.

In locations where the depth and relative transparency of water allows upward illumination from the river bed. dramatic lighting effects can be created.



1. Illuminated ocean Okinawa Japan
2. Illuminated river Seille France



- | | | | |
|--------|---|--------|--|
| Zone 1 | River Edge condition with mixed vehicular and pedestrian use | Zone 5 | Destination zone - with the potential for a significant public realm space |
| Zone 2 | River Edge condition with pedestrian access only | Zone 6 | Connective space with a potential riverside boardwalk |
| Zone 3 | River Edge condition with predominant vehicular use and restricted pedestrian access , with a potential for exclusive part- time pedestrian use | Zone 7 | Existing trail enhancement area |
| Zone 4 | Point State Park | Zone 8 | River Edge condition developed as a part of future developments |
| | | Zone 9 | Mon Wharf development |

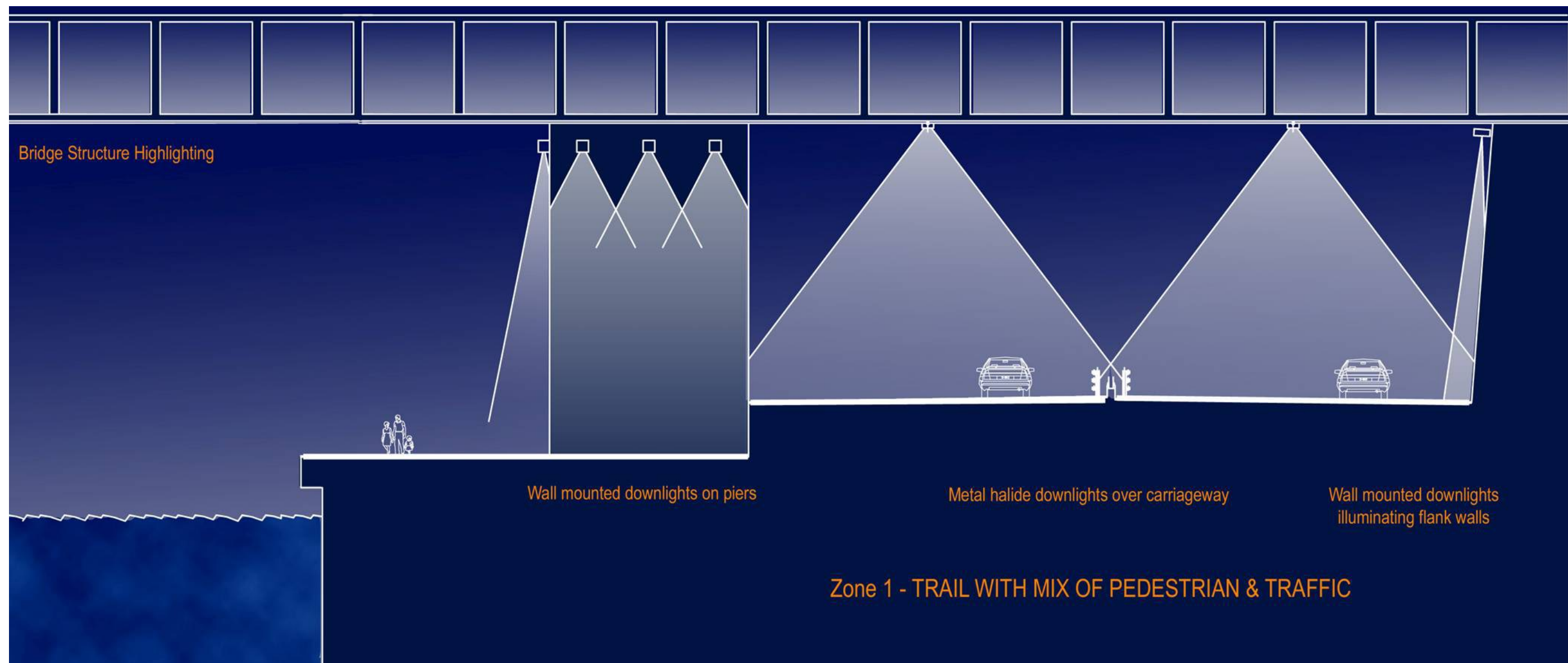
● Landing points

Zone definition - riverfront trail conditions

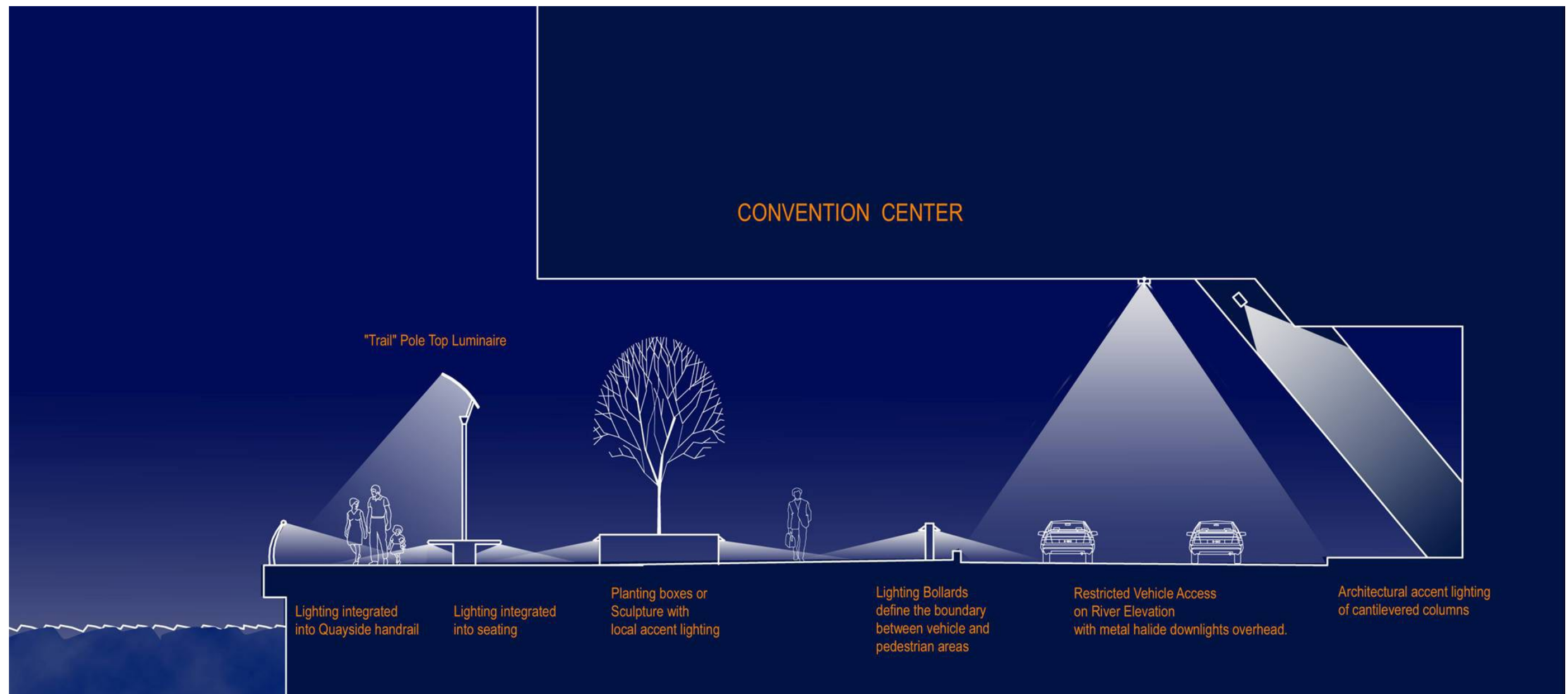
As Three Rivers Park is developed, the following lighting concepts will help create unique night time panoramas for the river front. A clear and legible lighting hierarchy will clearly define the trail even when the local environment changes along the route.

The lighting should consist of a number of distinct layers:

- Lighting for pedestrian safety and security,
- Landscape lighting,
- Lighting integrated into the design of benches and street furniture
- Building façade lighting (where appropriate)



In areas of mixed vehicular and pedestrian uses pedestrian use of the riverfront should be encouraged by ensuring that vertical surfaces and structures such as the piers of 9th Street Bridge and the embankment walls of Fort Duquesne Boulevard are illuminated at night. The lighting designs for these areas need to ensure that the carriageway lighting is properly focused onto the surface of the highway and does not obliterate the lighting of the adjoining pedestrian walkways.



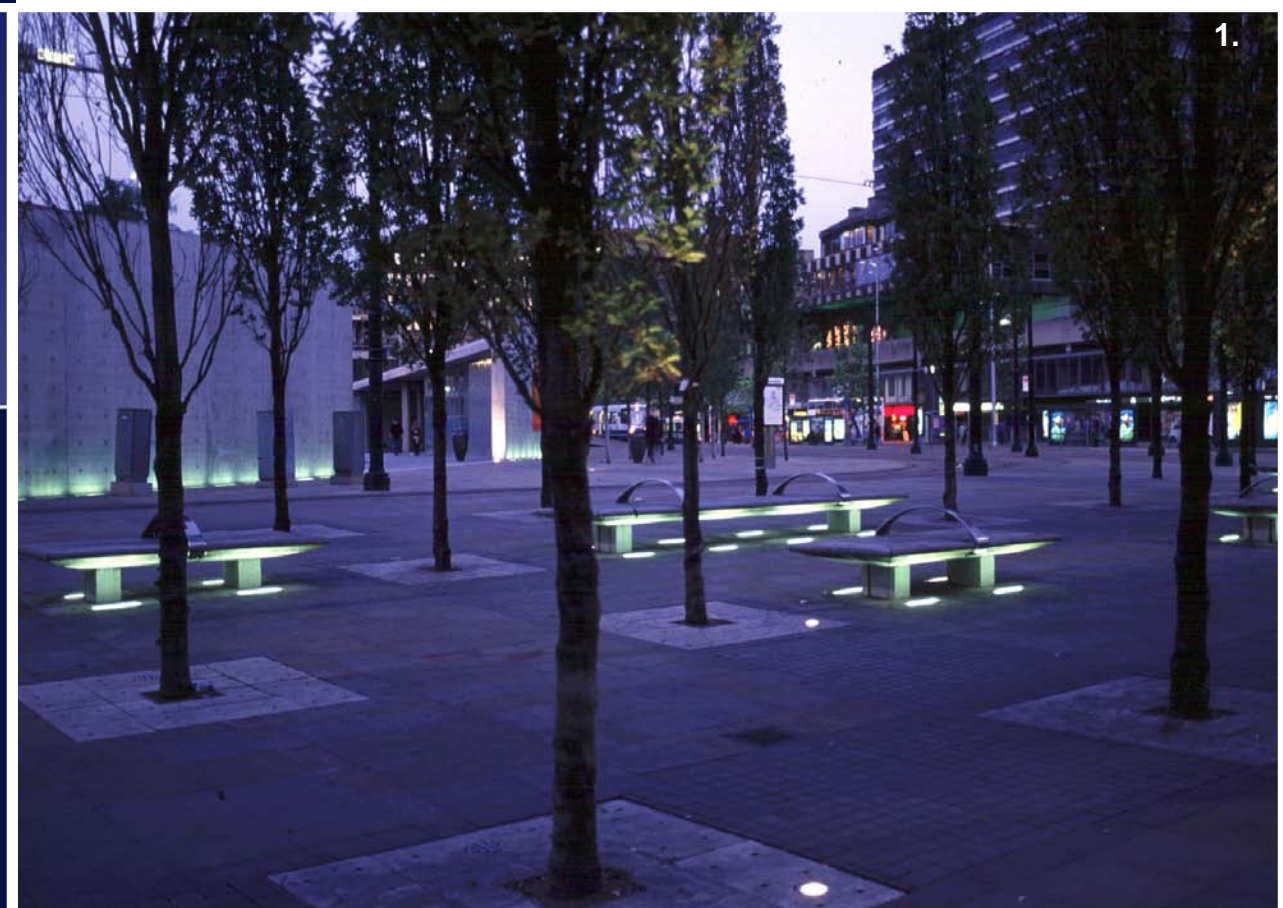
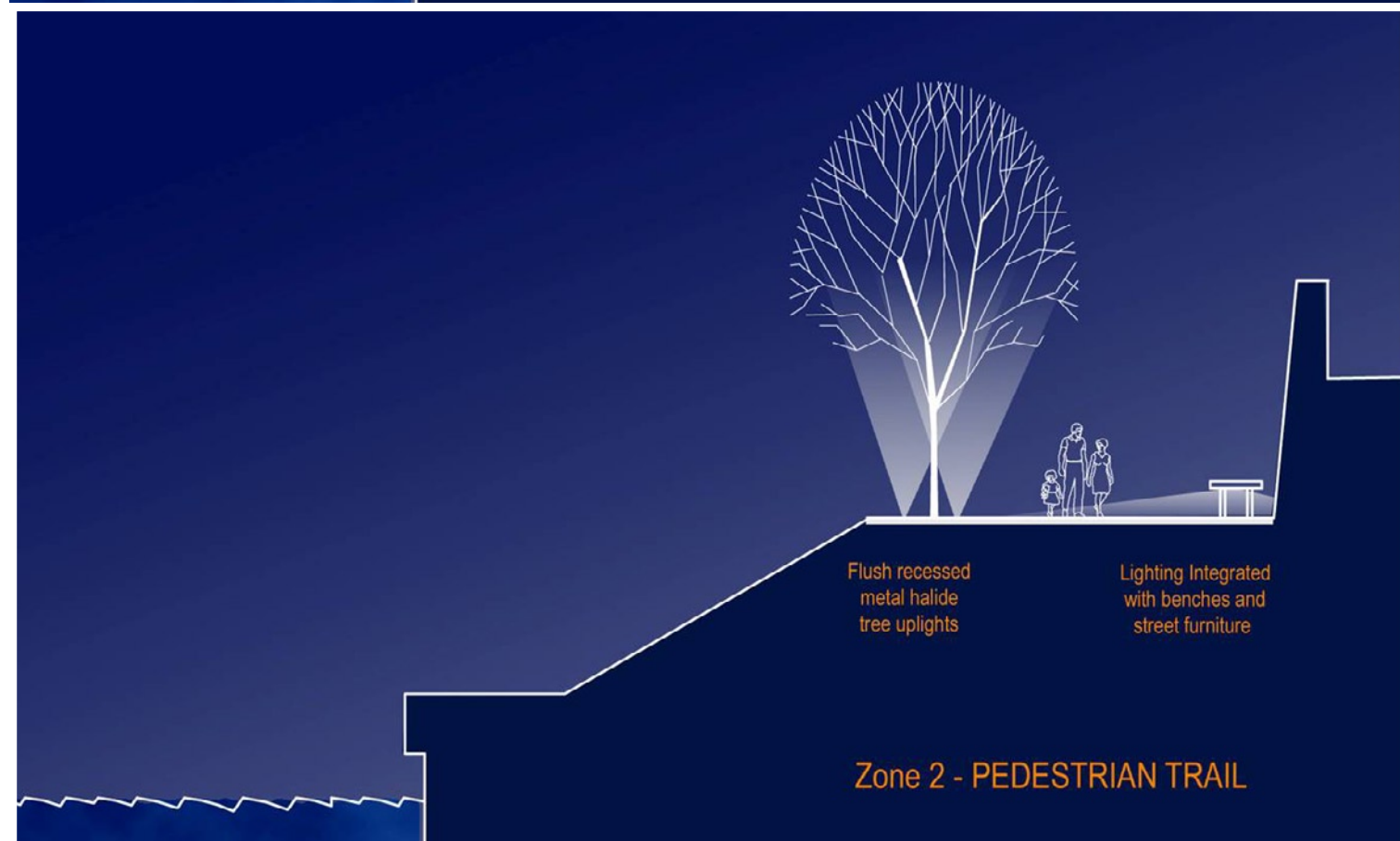
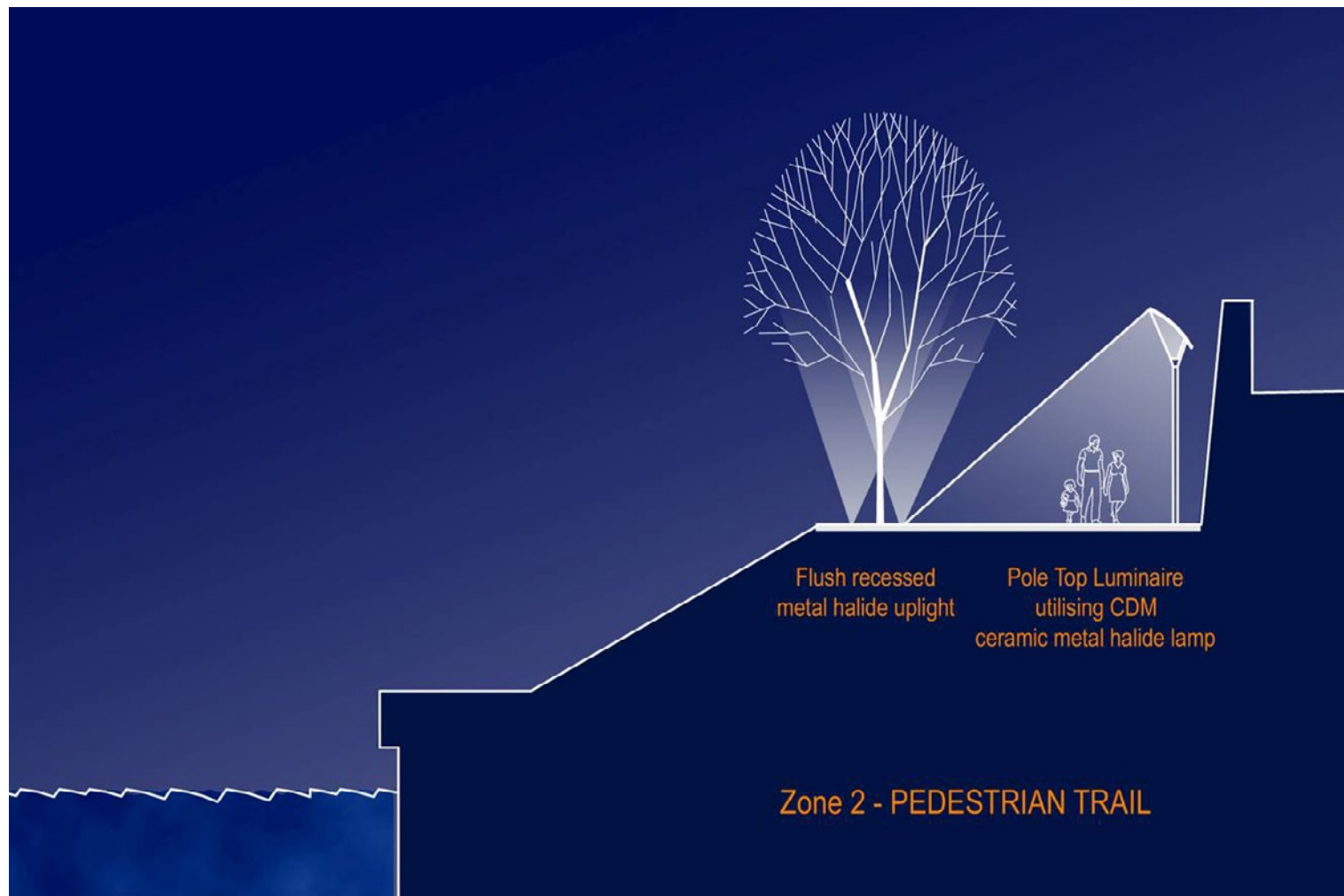
Prominent public realm locations in Three Rivers Park such as the riverfrontage of the Convention Centre need to be lit predominantly with low level bollards and lighting integrated into street furniture, creating a vibrant nighttime destination. Within these spaces vehicular traffic is either excluded or deferring to pedestrian activity. The form of the adjoining individual buildings needs to be expressed with lighting at pedestrian level as an active frontage.

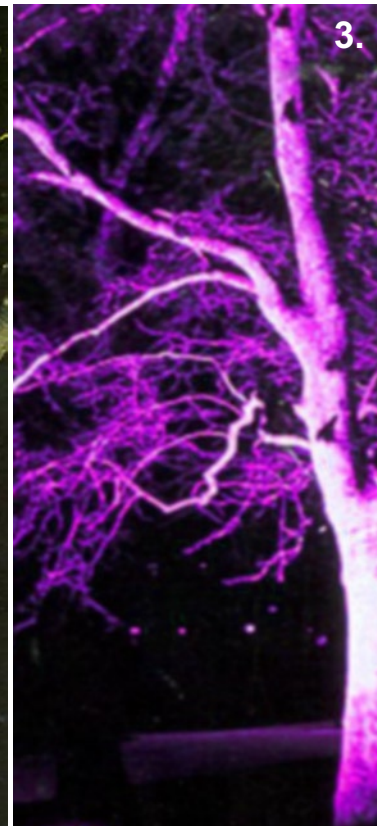
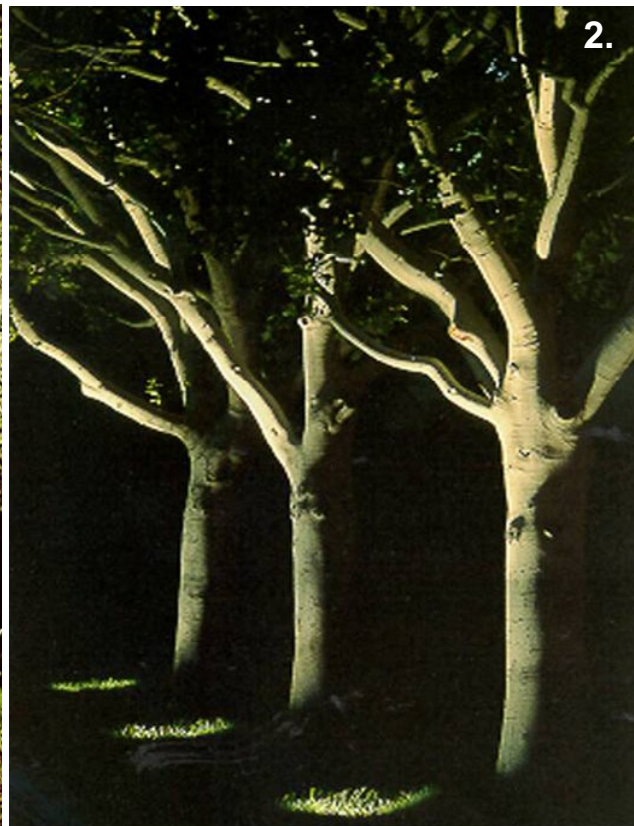


In most sections of the trail vehicles are excluded. In these locations it is important to provide comfortable lit environment that promotes pedestrian usage. Where possible, opportunities should be taken to highlight groups of trees and features of the landscape. This will prevent sections of the trail receding into comparative gloom and provide an illuminated vista that silhouettes pedestrian activity.

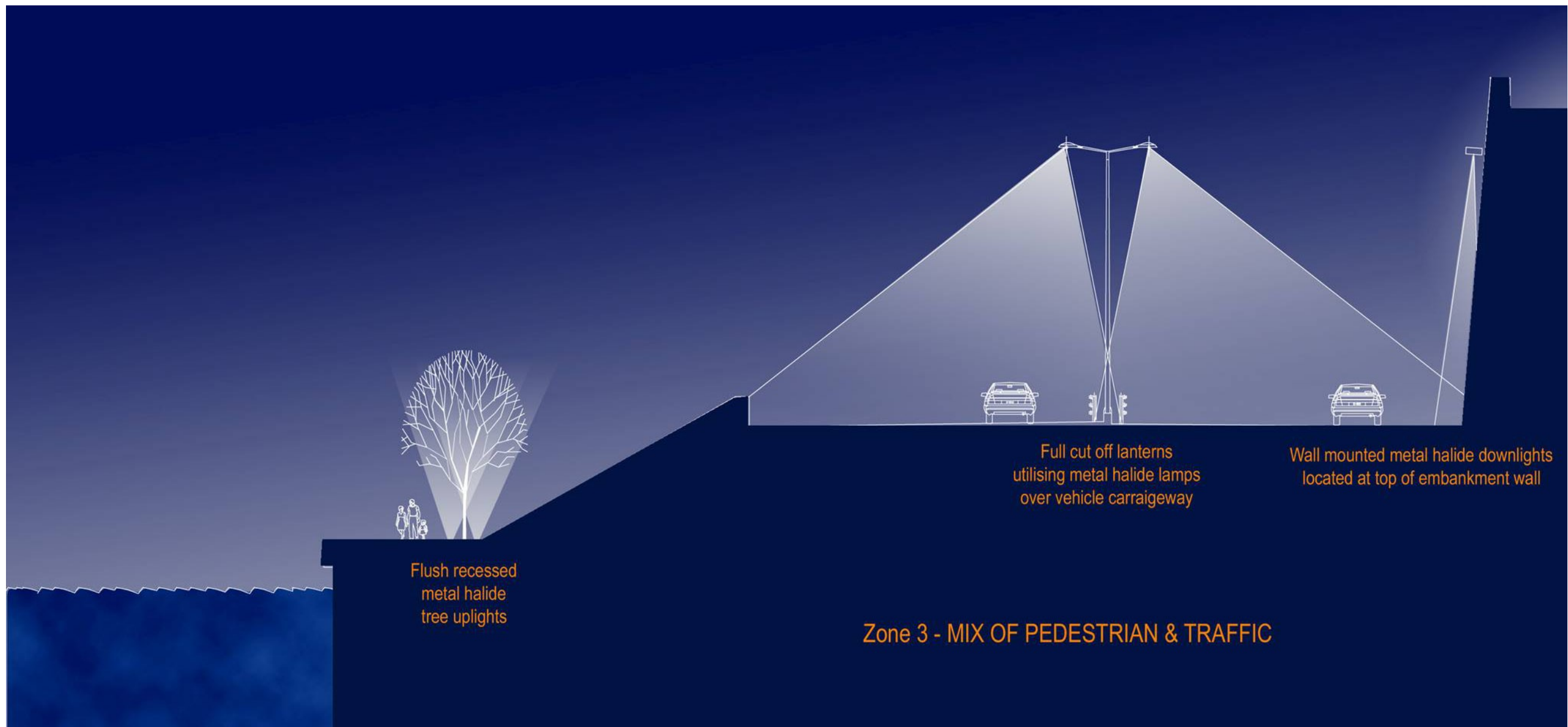
Landscape lighting should be used to reveal objects selectively. No attempt should be made to light everything within view. Modulating and composing the areas of brightness in a particular scene can introduce an additional sense of depth and perspective. The general lighting of the trail should clearly reveal the route and highlight changes of level and other hazardous points. A luminaire type with an indirect light that illuminates a large reflector is suggested since this will provide a good scalar illuminance. Although the horizontal illuminances achieved with such a luminaire may be lower than with a direct “cut-off” style lantern of the same wattage, the luminaires will provide comparatively higher values on vertical planes, which will provide greater visual acuity. People will be able to see well. The large indirect reflector style of luminaire has the added benefit that it will be much more visible from a distance, which will assist the legibility of the trail by day and night.

1. Piccadilly Gardens Manchester
Lighting design using underlit benches and tree uplighting





1. Uplighting trees when in full foliage
2. Uplighting trees in winter
3. Uplighting trees during the Festive Season
4. River Correze France bank illumination with uplit trees creating a mirror like reflection in the river
5. River walk Seille France - example of a comfortably lit pedestrian route with good overall nighttime vision
6. River walk seille France - example of using landscape lighting as a part of creating a nocturnal composition



The existing lighting on 10th Street Bypass & Fort Duquesne Boulevard has a cluttered appearance. There are pedestrian-scale prismatic “flambeau” luminaires, taller “acorn” shade street luminaires and wall mounted luminaires on the embankment wall. At night the overall scene is glaring and lacks definition.

A clear rationalisation of the existing hierarchy of luminaire types would create a more ordered appearance by day and night. The use of a single generic lamp type and colour for both roads and pavements is recommended. 3,000K warm white ceramic metal halide lamps would be in harmony with the lighting proposals for the pedestrian trails.

Both roadways should be illuminated with a single style of luminaire. A twin headed flat glass cut-off luminaire located on the central reservation is proposed.

The embankment wall should also be illuminated in a more uniform manner than is currently achieved, also utilising 3,000K warm white ceramic metal halide lamps.

The river walk itself should be illuminated with the pedestrian-scale indirect luminaire proposed elsewhere, with groups of trees and other features, such as bridge piers and sculptures illuminated to provide continuing interest along the trail.

Transforming embankment wall into a night time feature with light.



1. Creating a gateway space under a highway structure Amsterdam Holland
- 2.3. Lighting as a part of park furniture
4. Creating a mirror like reflection in water
- 5.6. 7. Fountain illumination

Although Point State Park is the centrepiece of the Three Rivers Park, it is important that the lighting themes applied elsewhere in the strategy are consistently applied here. The lighting solution adopted for the trails should be utilised along the river edge in this location to create a luminous band of white light that defines the peninsula. The avenue of trees that flank the hard-edged river walk should be illuminated with close offset flush recessed uplighters that strongly express the form of each tree. This will provide an illuminated backdrop to the spectacular programmable colour change lighting applied to a restored fountain. For a more detailed application of the lighting typology see concept section.

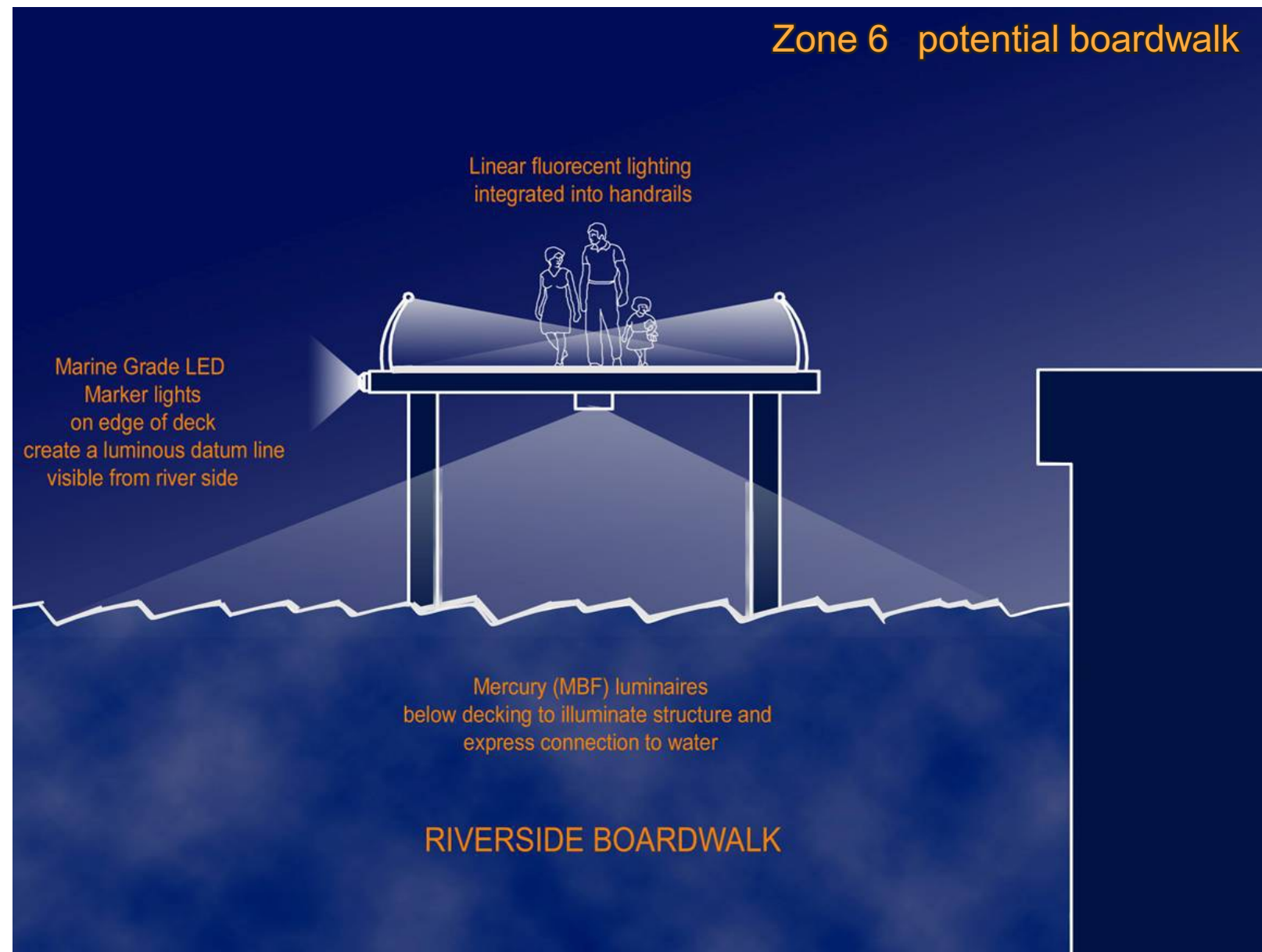
Zone 4 is an opportunity to create a vibrant urban space that will provide a focus for night time activity on the North Shore.

The ambient lighting of such a space should respond to and integrate with the landscape and architectural design and does not need to be “floodlit” to create a feeling of safety and security. Illuminated elements such as trees, benches and sculptures will help define the space and encourage visitors to make use of the urban space at night.

Dynamic, interactive lighting elements integrated into the hard landscaping design will create long term interest.

Contemporary artists could be commissioned or an international competition held to design site- specific artworks. Chicago's Millennium Park is a good recent example of how the involvement of world-class architects and artists in this type of development can attract the considerable international attention.

Zone 6 potential boardwalk



The construction of new riverwalks and landings was a key component of the May 2003 “Connecting The Loop” strategy.

River landings would encourage greater use of the river and make currently isolated sections of the trail more accessible. “Connecting The Loop” also suggested ferry services as an alternative means of crossing the river. A lookout and a secondary boardwalk trail following the shoreline were originally proposed for the North Shore West and West Carson Street in “Connecting The Loop”. The lighting of river landings and boardwalks should be integrated with the design of the structure itself. Integral handrail lighting can provide general lighting and emergency for pedestrian safety and security. Coloured marker lights located on the outboard edge of the boardwalk would serve to identify the location of each landing. Additional lighting located under the boardwalk itself would express the connection the river. The lighting of landing and boardwalks should avoid glare to river traffic. Care should be taken in the selection of appropriate marker lights to avoid colours that might be confused with marine navigation signals.

1. Bridge boardwalk illumination Canary Wharf London
2. Boardwalk illumination Hungerford crossing London
3. Boardwalk scheme Shiokaze Japan



Zone 7

This is an existing section of trail on the South Shore located between Fort Pitt Bridge and Panhandle Bridge, which runs alongside the Station Square development. In this location the trail is separated from the river by the railroad tracks.

The use of the “iconic” trail luminaire for general illumination in this location would clearly identify this segment as part of Three Rivers Park.

Opportunities for providing accent lighting to shade structures, benches and trees should be explored, as part of future enhancements to the trail.

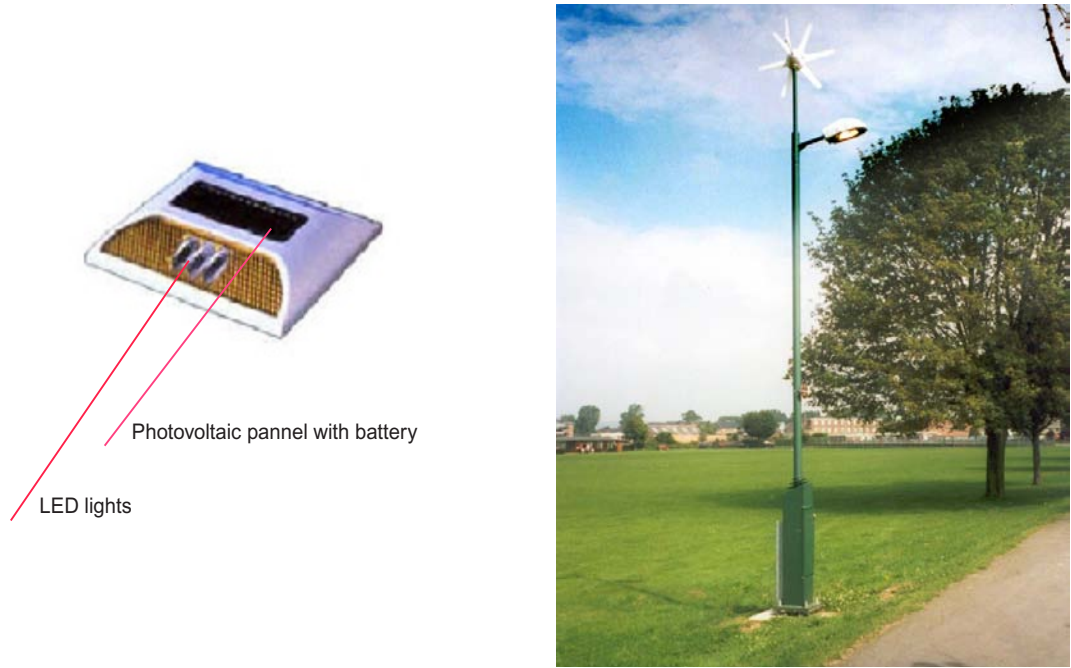
Zone 8 (and sections of Zone 2+6)

Connecting the Loop” proposed establishing a new trail and water landing in this location, leading from Liberty Bridge, past the South Side of Terminal Buildings along Bingham Street to the 10th Street Bridge. Being completely landlocked, this section of trail would be completely different in character from the rest of Three Rivers Park. The use of lighting to identify the trail is particularly important in this location.

In addition to the typical “trail” luminaire, the use of additional graphic devices such as floor recessed LED marker lights, or “passive” reflectors such as cat’s eyes would assist in way finding, past Terminal Buildings and along Bingham Street.

In sections of the riverfront trails where the city transitions into an open landscape a classic underground or overground electricity cable supply is not appropriate both in terms of cost and environmental impact. The recent new generation of lighting equipment using renewable energy is ideally suited for luminous signaling of trails and water edges

LED marker light dimension 4” by 3”



Wind powered lighting





The external lighting at the Mon Wharf Development should consist of a number of layers.

Lighting for pedestrian safety and security could consist of the Three Rivers Pole Top Luminaire to define the trail and illuminated bollards located on the quayside and boardwalks.

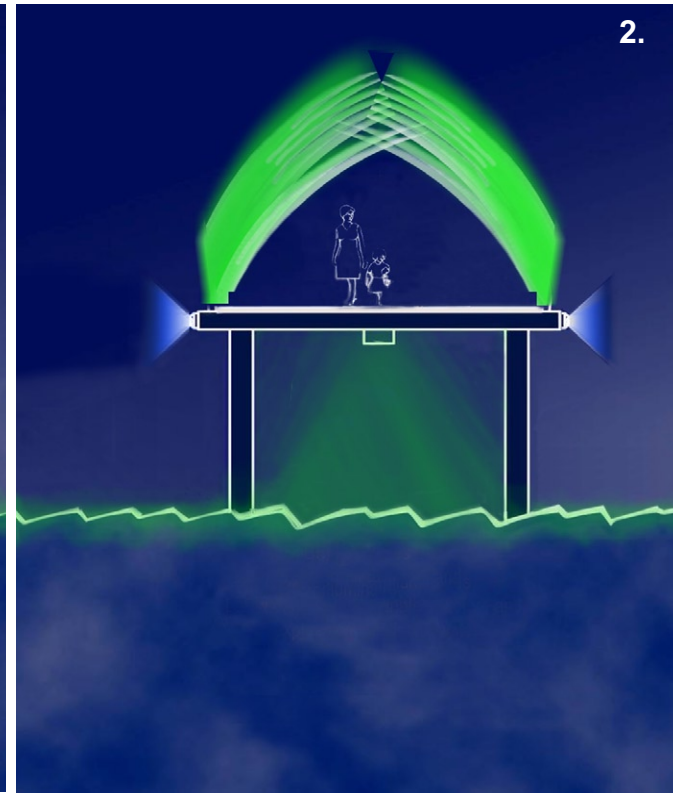
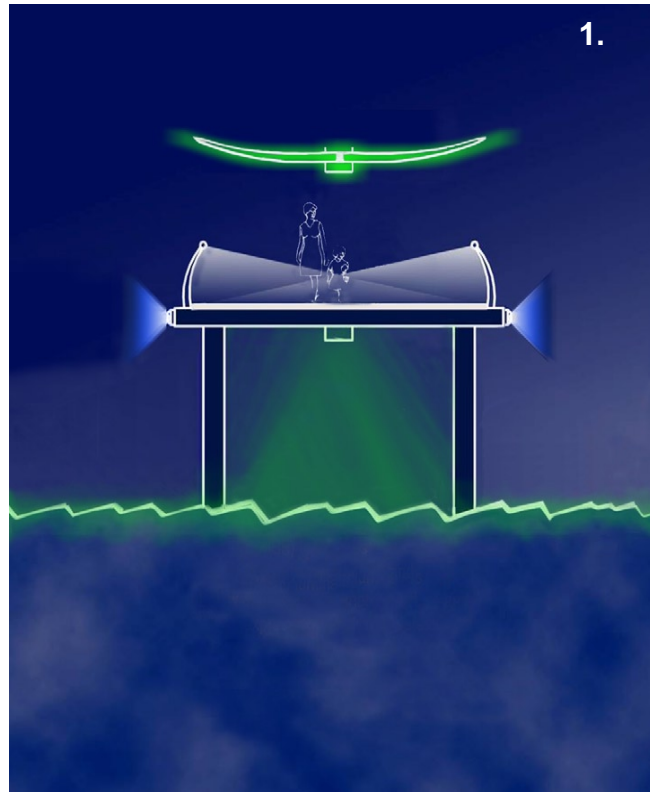
The underside of the raised highway presents an opportunity to create a vibrant and stimulating environment at night.

The underside of the structure could be lit in deep blue utilising metal halide uplights with deep blue borosilicate glass filters mounted onto the face of the columns to illuminate the soffit above. The columns supporting the road could be strongly accented in white light with very narrow beam surface mounted metal halide downlights that would graze light vertically down the front face of the structure.

Large scale pylons and public art pieces could be internally illuminated at night perhaps incorporating colour change to create a vibrant and exciting experience for visitors.

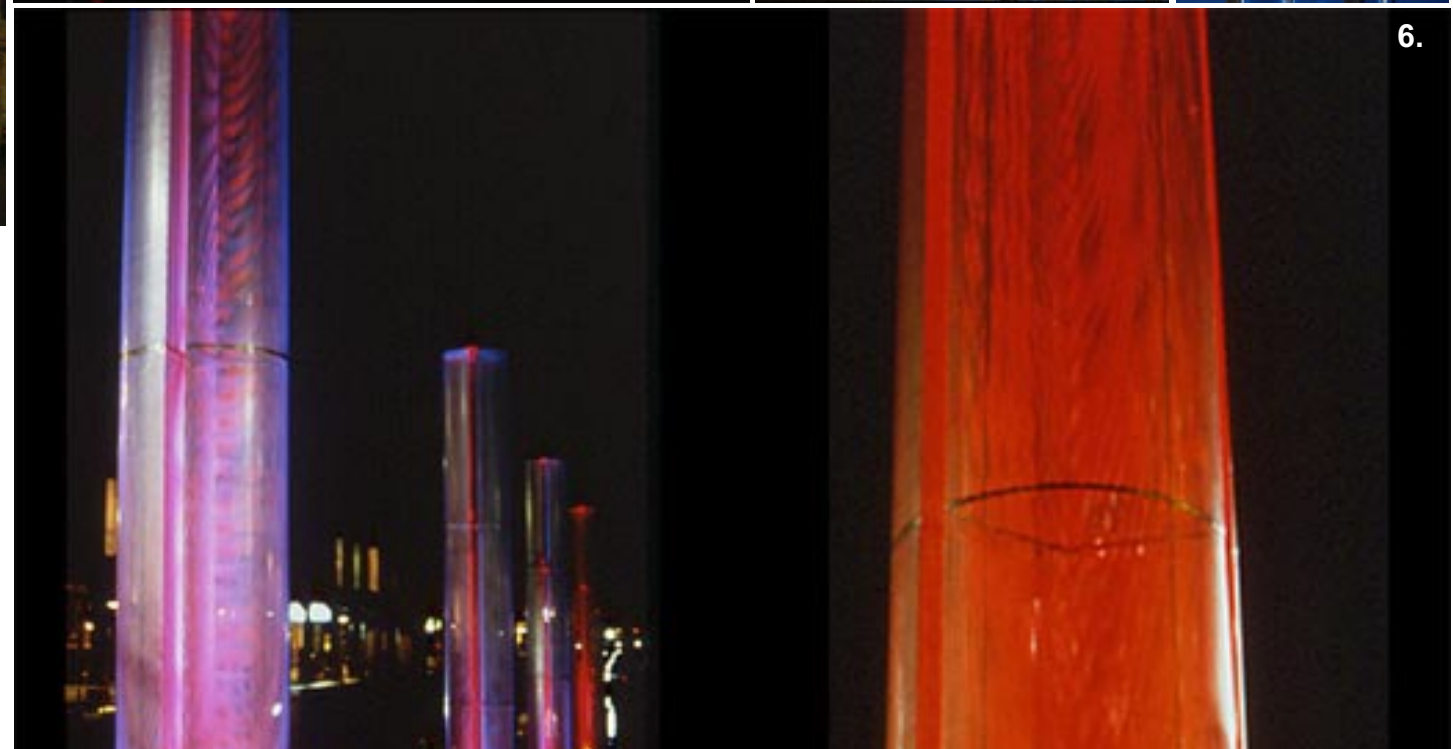
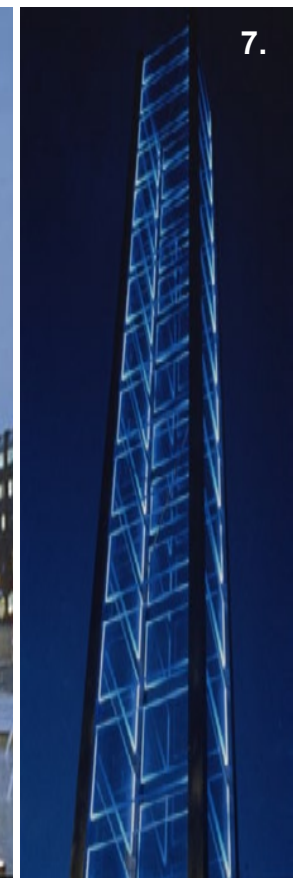
Trees and other planting elements should also be highlighted with discreet flush recessed in ground uplights.

For a more detailed application of the lighting typology see concept section.



Landing points

The existing and the newly planned boat landing points in Three Rivers Park need to be lit in a distinct and yet complimentary manner. The lighting design needs to emphasize both the water borne connectivity as well as the distinctness of the individual destinations. The landing points could be transformed into public art works through a creative linkage of lighting and interpretative signage.



1. Landing point with a canopy branded with green light
2. Landing point with a public art work envelope
3. A necklace of lit landing points Venice Italy
4. Public art work as a landing beacon South Shield Harbour UK
5. 6. Harbour Beacons Bristol UK
7. Public art work light beacon UK

The lighting of the twelve bridges spanning the Allegheny, Monongahela and Ohio rivers in the Three Rivers Park needs to form a coherent nighttime visual experience. Its is ultimately the cumulative effect of all the bridges being lit, which will provide the strongests expression of the Three Rivers Parks aspirations as well as the most significant contribution to the cumulative nighttime panorama of Pittsburgh.

Version A illustrates how a baseline transformation of all the bridges could be achieved through encoding only the bridge piers with light. The singular focus on the piers will be the most cost effective way of achieving a sense of narative progression, visual connection with the water and of a celebratory transformation. The detailed design will need to explore how colour light could be used for example :

- in creating the City of Golden Bridges - this approach would require the use of golden hue light on all bridge piers
- in celebrating the individual identity of the Three Rivers with specific colors for example blue for the Allegheny,orange for the Monongahela rivers and green for the Ohio river

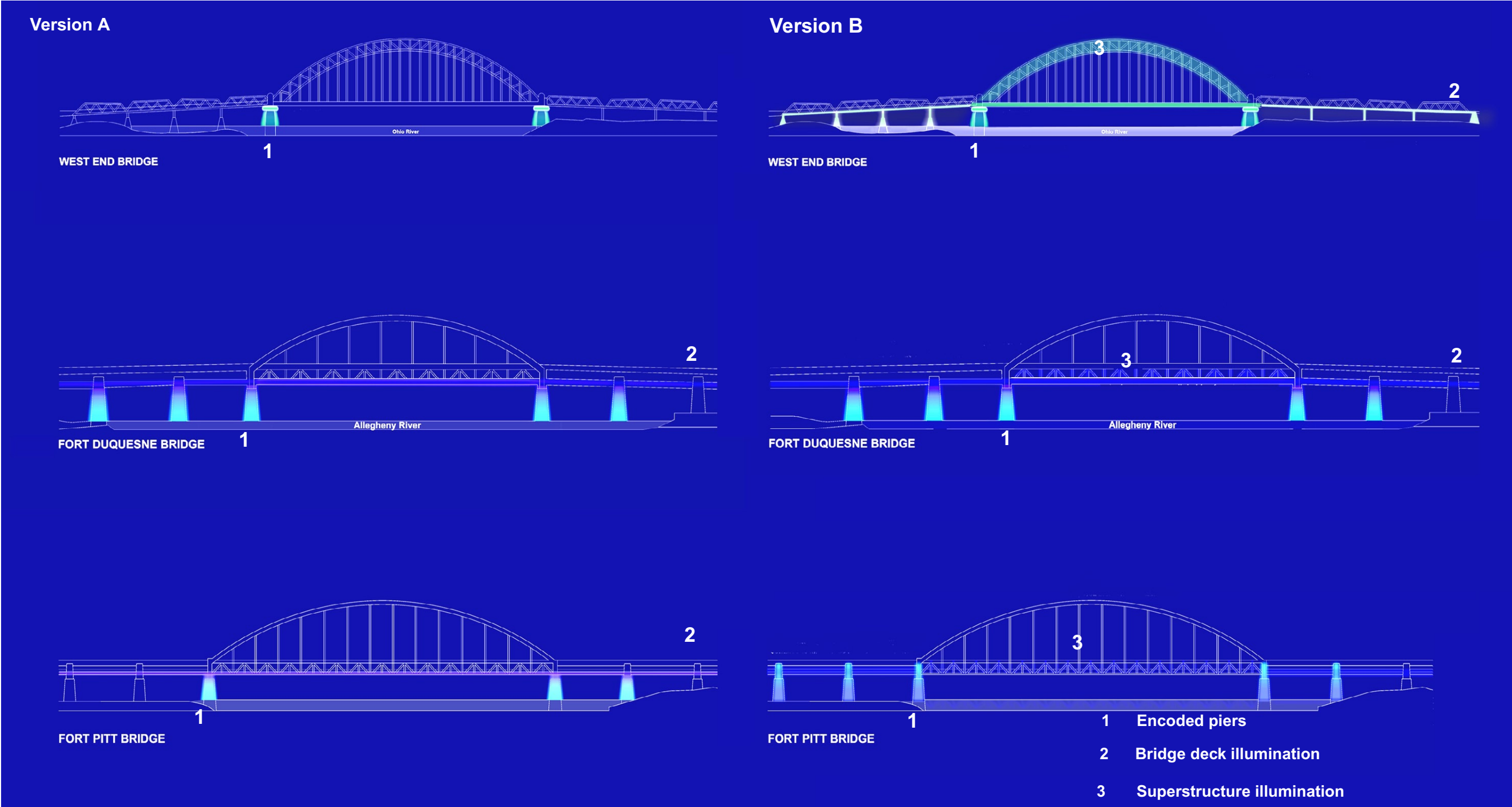
This approach would also sit comfortably with the already implemented bridge lighting schemes and could be realized in phases.

Phase 1 starting with the Gateway Landmark West End Bridge and the two highway Ft. Pitt and Ft. Duquesne bridges

Phase 2 Roberto Clemente, 7th and 9th street bridges

Phase 3 Smithfield, Panhandle and Liberty bridges

Phase 4 Ft. Wayne Railway, Veterans, Liberty and South 10th street bridges



Version A



ROBERTO CLEMENTE BRIDGE

1



SEVENTH STREET BRIDGE

1



NINTH STREET BRIDGE

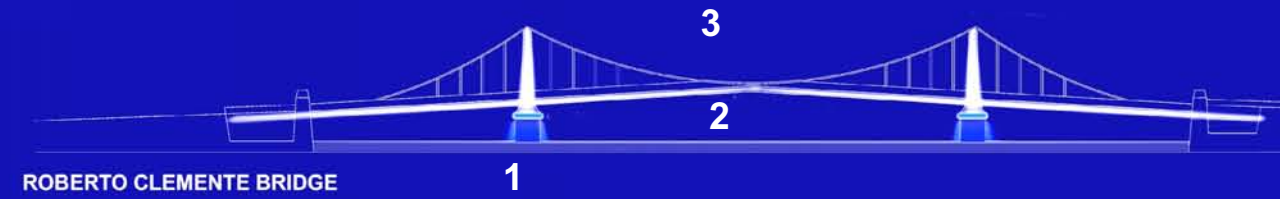
1



FORT WAYNE RAILROAD BRIDGE

1

Version B



ROBERTO CLEMENTE BRIDGE

1

3

2



SEVENTH STREET BRIDGE

1

3

2



NINTH STREET BRIDGE

1

3

2



FORT WAYNE RAILROAD BRIDGE

1

3

- 1 Encoded piers
- 2 Bridge deck illumination
- 3 Superstructure illumination

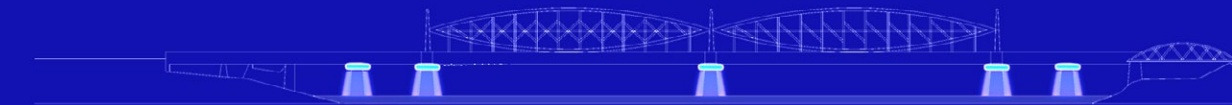
Version A



VETERANS BRIDGE



SIXTEEN STREET BRIDGE



SMITHFIELD STREET BRIDGE

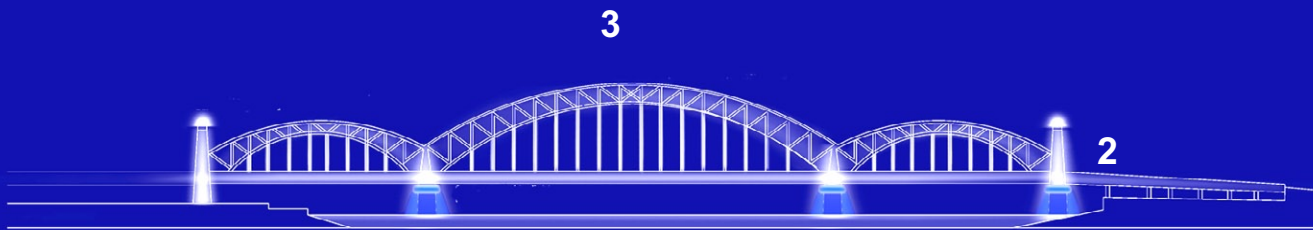


PANHANDLE BRIDGE LRT

Version B



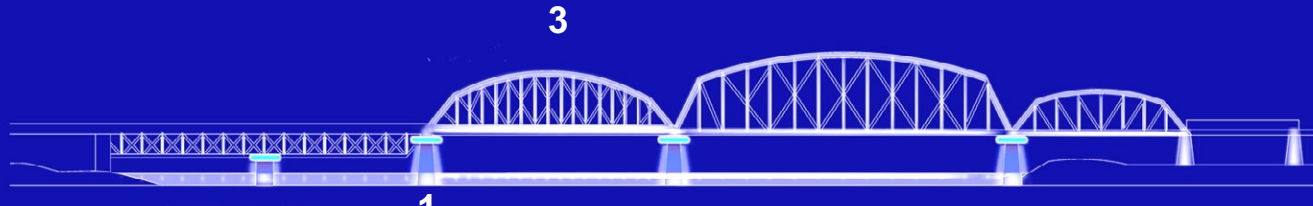
VETERANS BRIDGE



SIXTEEN STREET BRIDGE



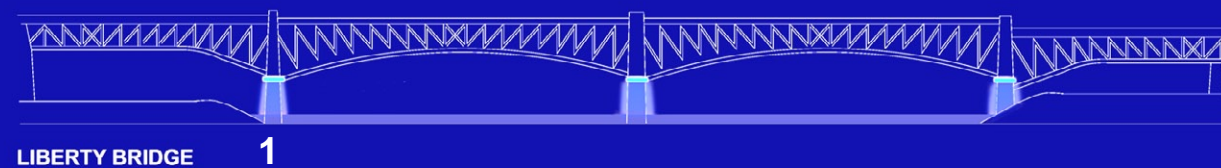
SMITHFIELD STREET BRIDGE



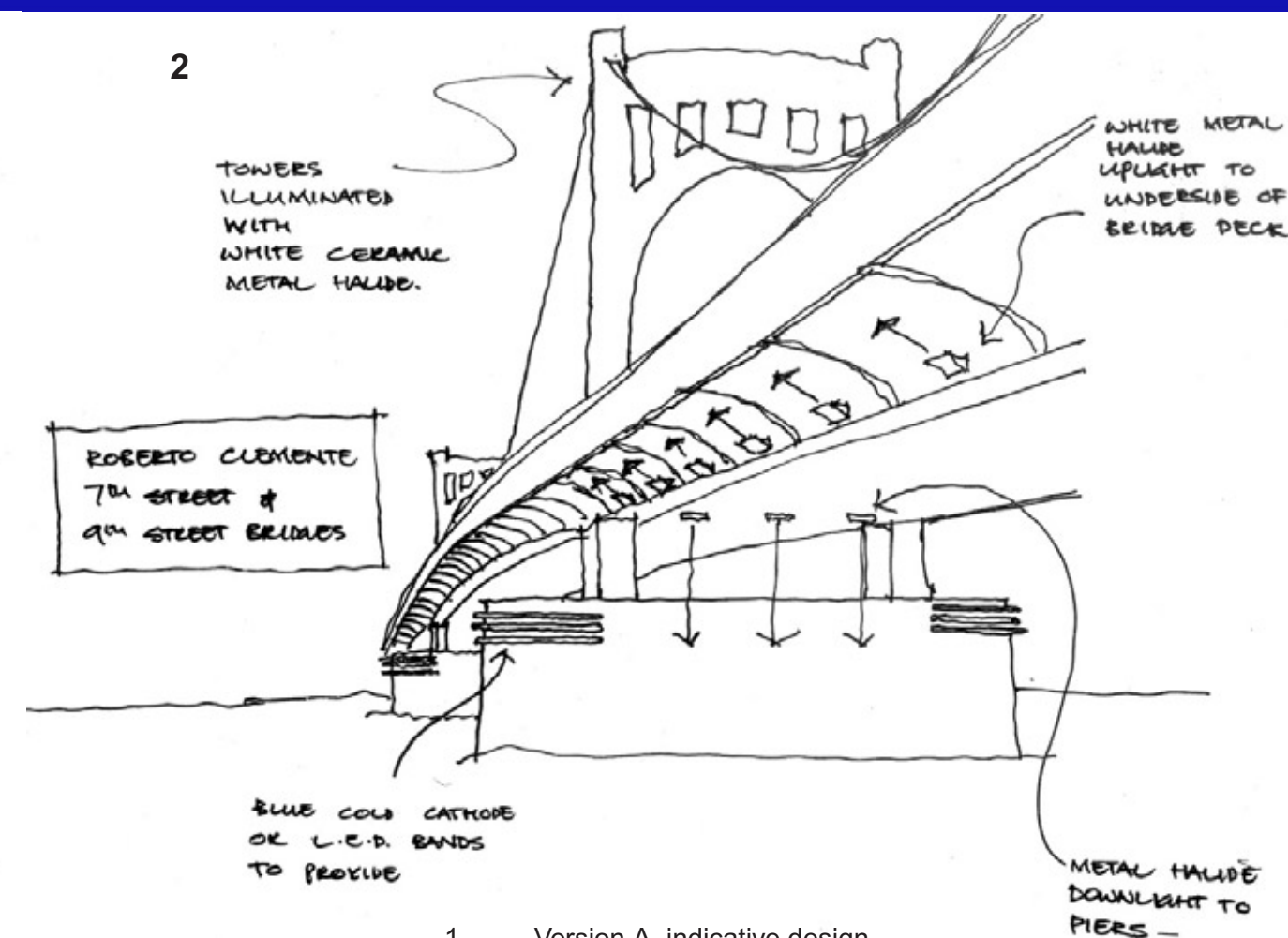
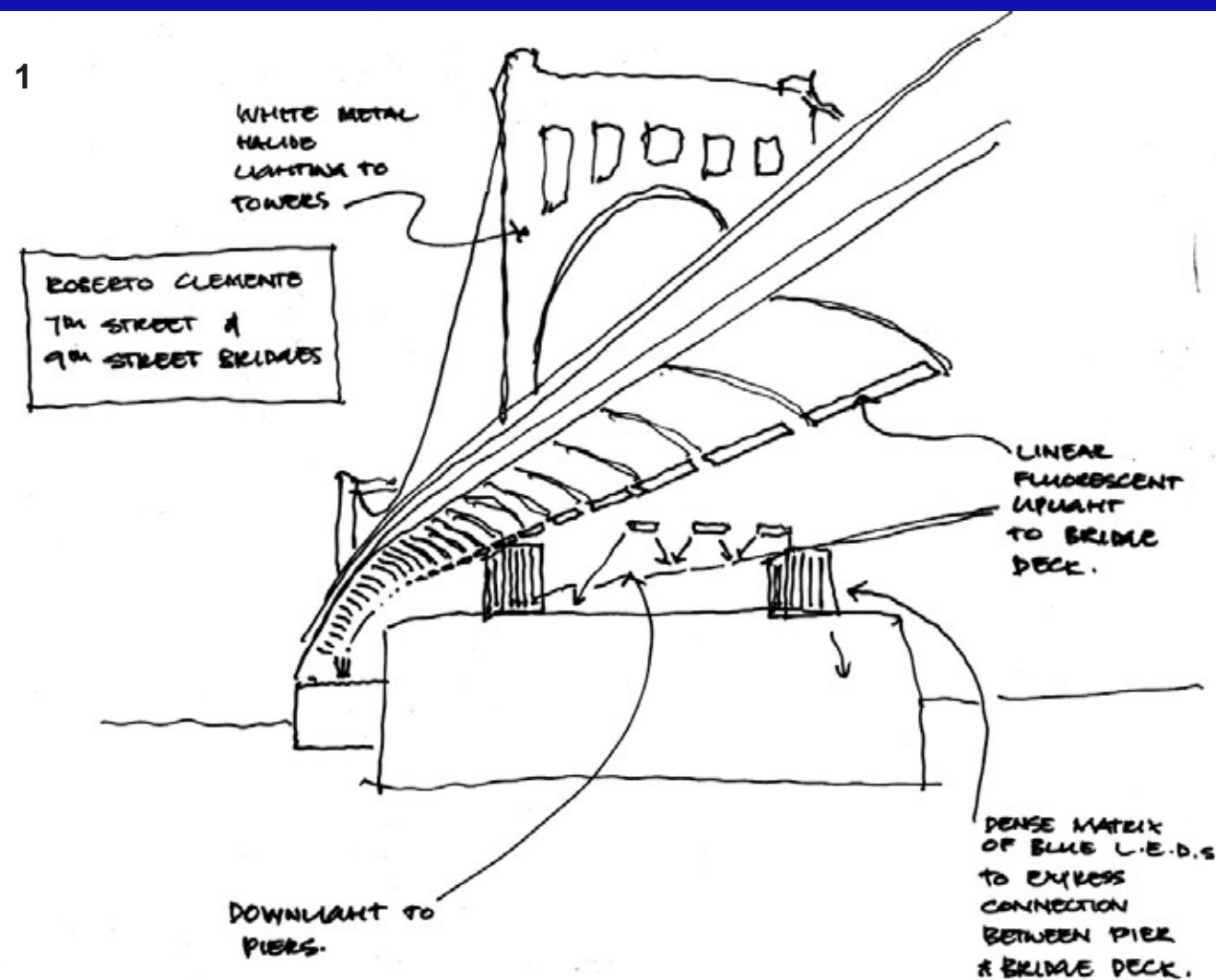
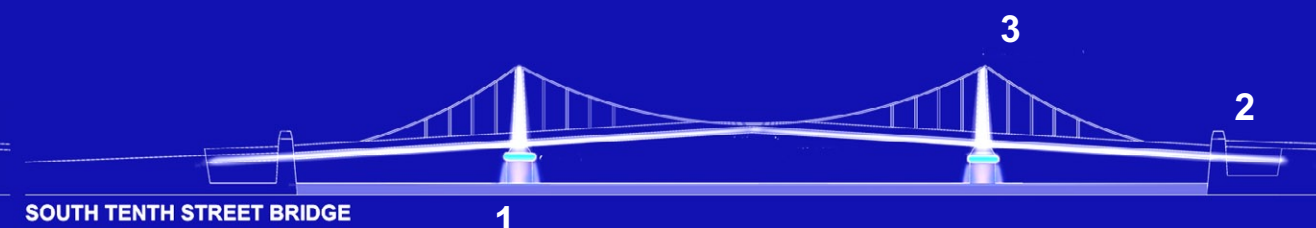
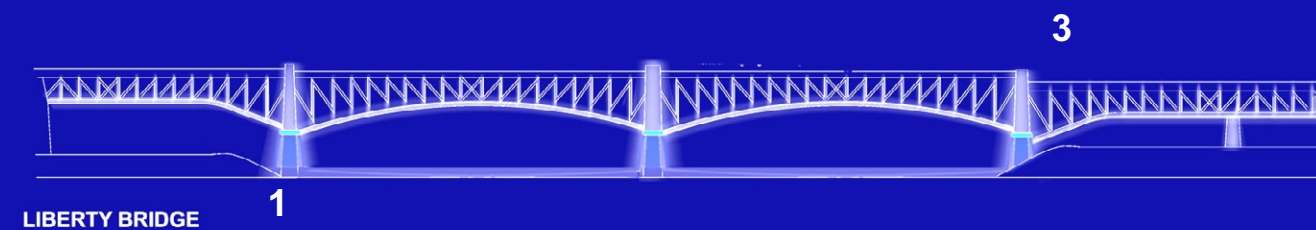
PANHANDLE BRIDGE LRT

- 1 Encoded piers
- 2 Bridge deck illumination
- 3 Superstructure illumination

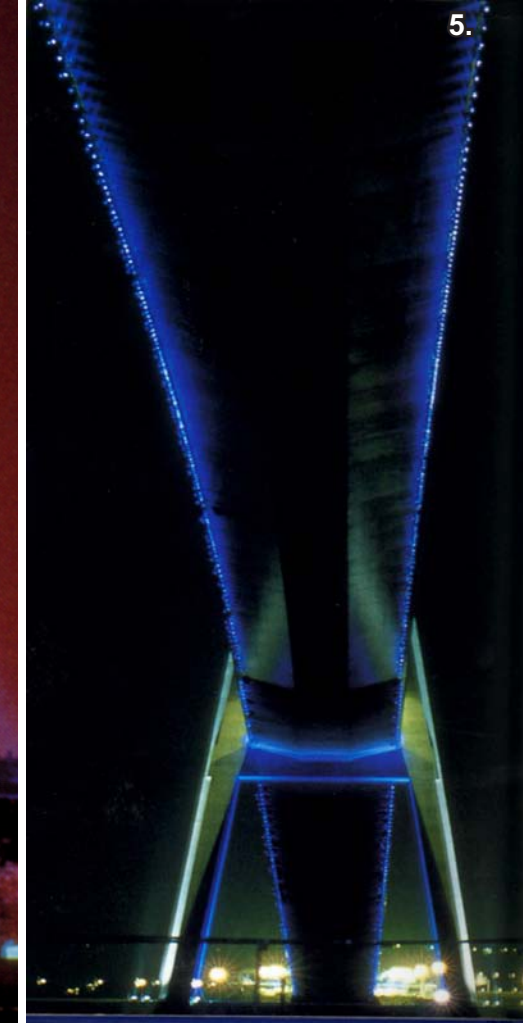
Version A



Version B



1. Version A indicative design
2. Version B indicative design



The lighting design for the twelve bridges within the Three Rivers Park needs to address how the vehicular illumination of the bridge decks could be standardized both in quality and color of light as well as in terms of luminaire design, optical performance, glare and visual brightness control.

The introduction of internal louvers or reflectors within the fittings may be utilised to re-direct their generally diffusing distributions downwards, improving their optical performance. General illumination levels upon the horizontal working plane will be enhanced and indirect spill light, contribution to light pollution reduced.

Control of their surface brightness will also aid in creating a balanced overall streetscape as the luminous intensity and glare of the fittings is reduced.

Holistic use of lamp sources will also benefit future maintenance regimes and rationalise spares. Generally contemporary lamps also offer the benefit of enhanced energy efficiency and longevity.

Day time/Night time Appearance

The luminaires could also be treated as daytime 'visual sculptures' but during the night time be unlit. Conversely the luminaires can be concealed within the bridge structure with minimal visual impact both during night and day.

1. Evenly lit bridge deck with no upward or side light spill
2. Effectively lit superstructure of a lifting bridge Lyon France
3. + 4. Effectively concealed luminaires within the bridge structure Kobe Jsapan
5. Underdeck of a bridge lit to interactively respond to vehicular traffic flows



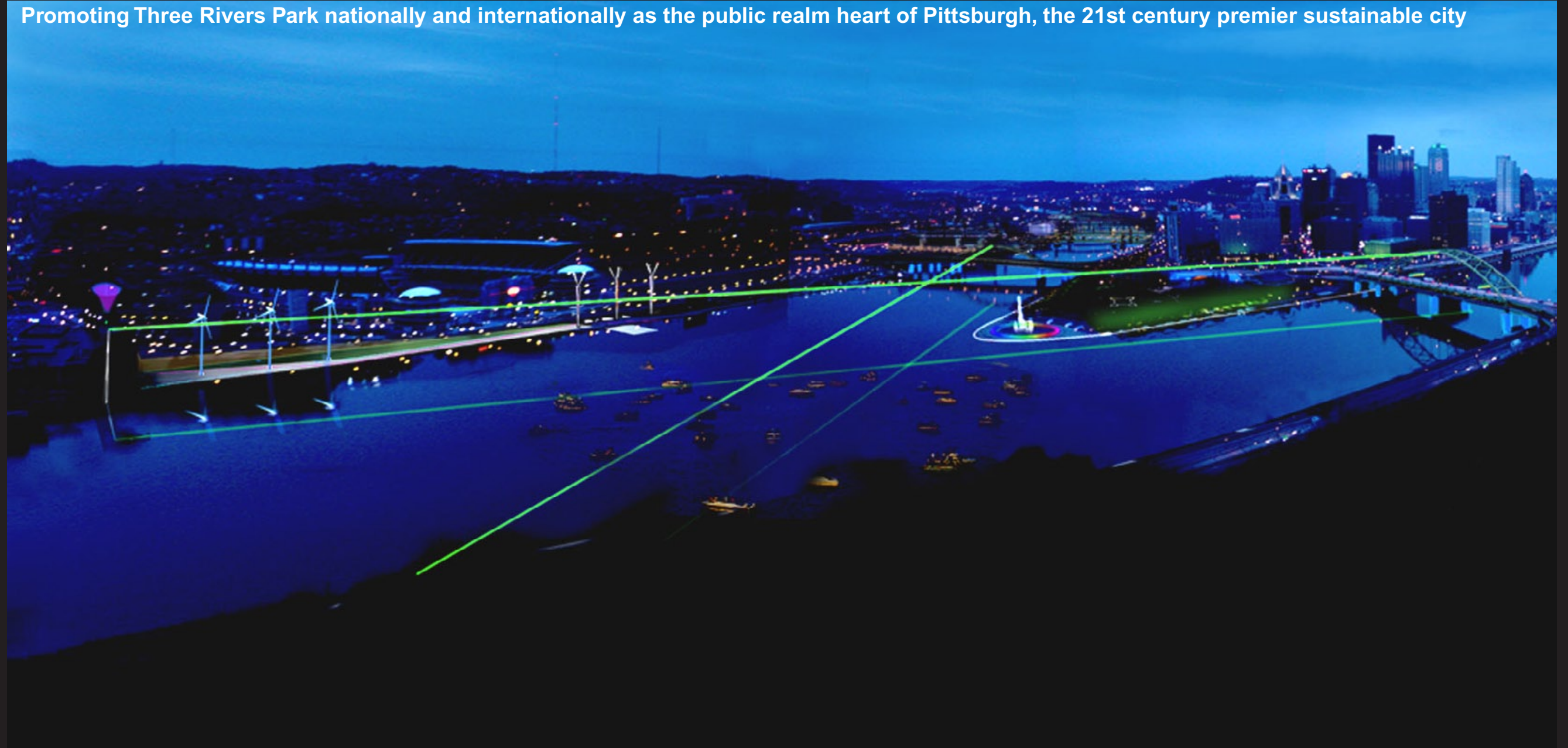
Concept and Opportunities

This section of the Lighting strategy for Three Rivers Park explores some key conceptual ideas by Art2Architecture for permanent and temporary projects

The focus is on ideas for:
the confluence
public realm space ideas
cultural revival and celebration



Promoting Three Rivers Park nationally and internationally as the public realm heart of Pittsburgh, the 21st century premier sustainable city



Ohio Gateway of Light

At its peak Pittsburgh was recognised as the world's industrial powerhouse with the drama of the industry being its big defining aspect. A major part of Pittsburgh's new identity is its restored natural setting as well as the social/cultural significance.

Since the 21st century is marked by an increased recognition of the sustainability and liveability agenda it would be highly appropriate to celebrate and mark in time the aspirations and visions of Pittsburgh's Three Rivers Park with a new kind of monument using the immaterial medium of light. A dramatic laser gateway, not seen anywhere else in the world, emanating from the two banks of the Ohio river up towards the Monongahela and Allegheny rivers offers to create a visually arresting celebration of the confluence and of the Golden Triangle. The laser installation would visually bind the water and land edges, expressing the scale of the Three Rivers park as a premier public realm destination.

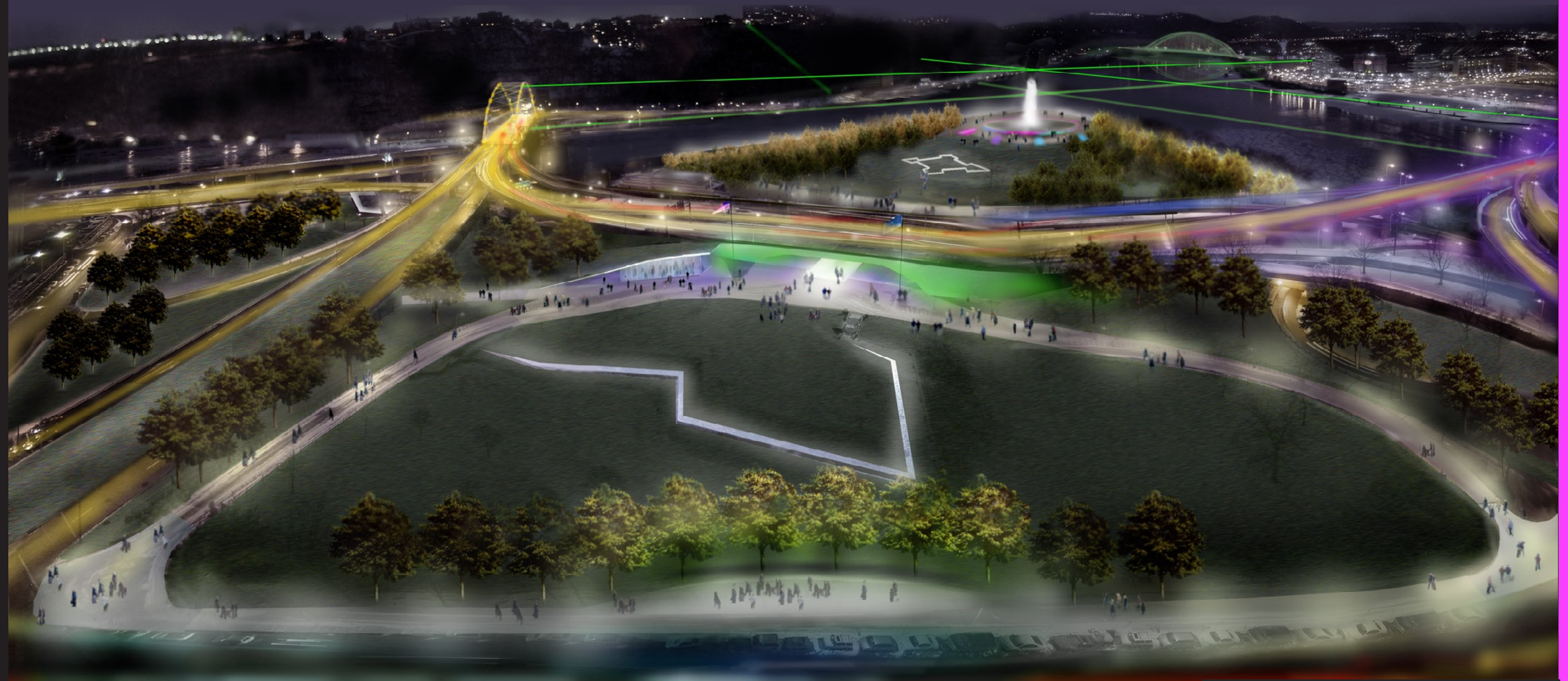
Art2Architecture proposal aims at creating a unique, high tech, visually dramatic and yet immaterial monumental gateway - the 'Eiffel Tower effect' that Pittsburgh never had.



1. Ohio Gateway of Light as seen from the North Shore next to Ft. Duquesne bridge

Promoting Three Rivers Park nationally and internationally as the public realm heart of Pittsburgh, the 21st century premier sustainable city

1.



The unique effect of the Ohio Laser Gateway would:

Restate the historical significance of Pittsburgh and Three Rivers Park as a gateway to the West
Promote and brand Pittsburgh as a welcoming city of Light , a high tech knowledge based city
Contribute to the development of the night time economy

The Ohio Laser Gateway would directly contribute to:

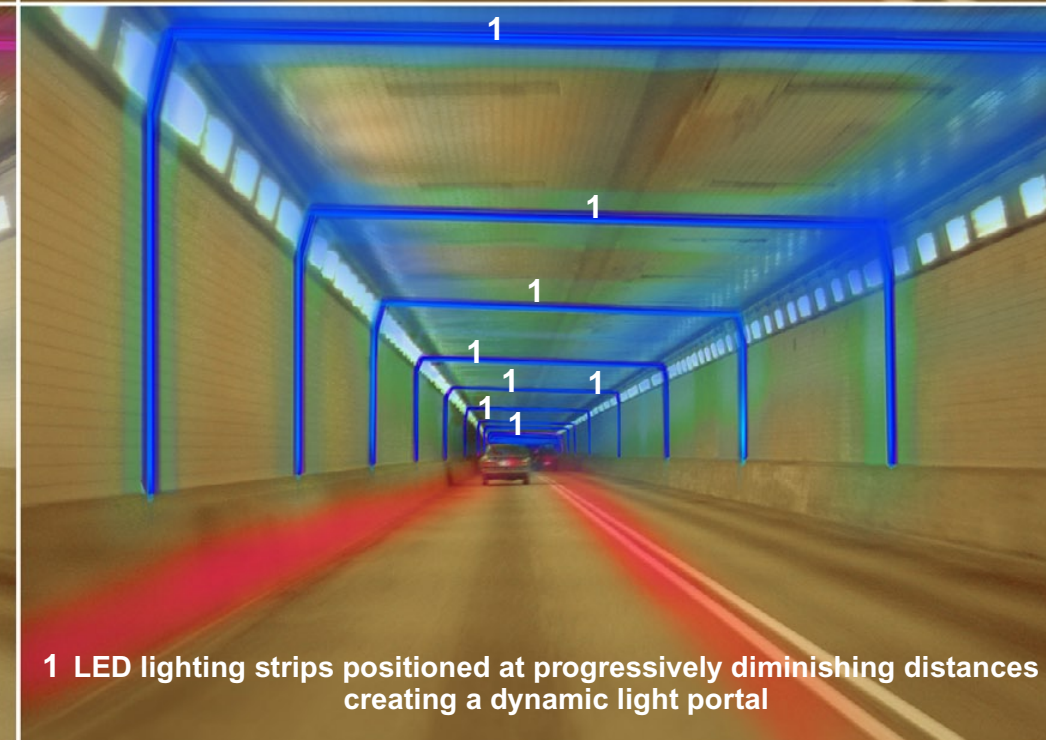
the development of tourism
the development of the night time economy
the development of cultural activities in the Three Rives Park - a gateway for its creative programming

1. Ohio Laser Gateway as seen from Point State Park

2. "aquatic public realm" - destination for river users a natural gathering point for boaters providing a strong increase in revenue in local marinas and restaurants

2.





1 LED lighting strips positioned at progressively diminishing distances creating a dynamic light portal

Fort Pitt Tunnel Lighting

The Fort Pitt Tunnel is a major and vital link into Pittsburgh. When exiting from the tunnel one is immediately confronted with the vertical scenery of the high-rise buildings making this moment hard to forget. The tunnel itself can provide an interesting spatial setup for a permanent lighting installation which would further enhance the experience of both entering and leaving Pittsburgh.

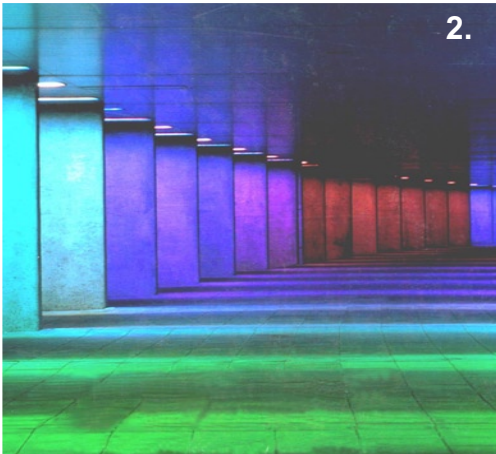
Responding to key projects

The full implementation of the Three Rivers Park could take a couple of decades. Within this time frame projects such as Point State Park and Mon Wharf could become a powerful way of advocating in the public mind the role lighting can play not only in making the rivers and their shorelines inspirational but also in the delivery of the related economic/social benefits.

Lighting clearly has a defining role to play in the development of these projects, as well as in the broad reintegration of these spaces into the fabric of the inner city core.

In the context of the Lighting Strategy the associated challenges are:

- 1. Finding ways of implementing lighting based projects as a uniquely appropriate way of keeping the Three Rivers Park vision in the public eye as a coherent inspirational concept.
- 2. Putting into place legislative and incentive mechanisms for the adoption into and implementation of the good practice recommendations



Point State Park

As a part of composing the bigger night time panorama, the lighting design for Point State Park needs to respond to the long, medium and short distance vistas.

The lighting design for Point State Park needs to explore how a unified application of white metal halide lighting in the Three Rivers park can be combined with a carefully targeted use of colored light.



A Mount Washington white lit urban rim

B branding Three Rivers Park with green light

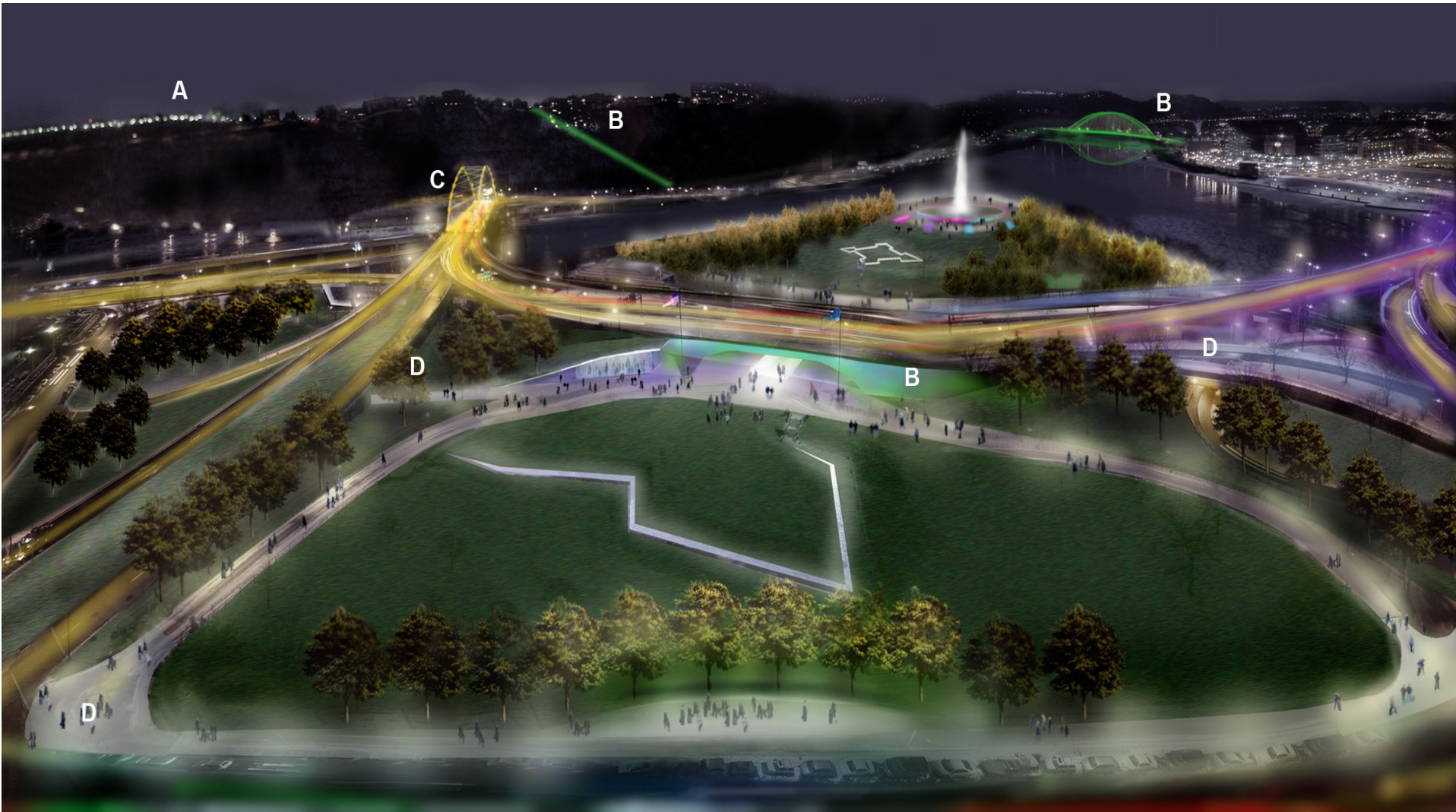
C highway corridor lighting

D new gateway spaces

E white metal halide lit circulation routes

Examples of using color light to transform large structures

- 1. Harbour edge, Holland
- 2. Highway undercroft, Holland
- 3. Elevated highway, Miami FL
- 4. Sydney Opera House

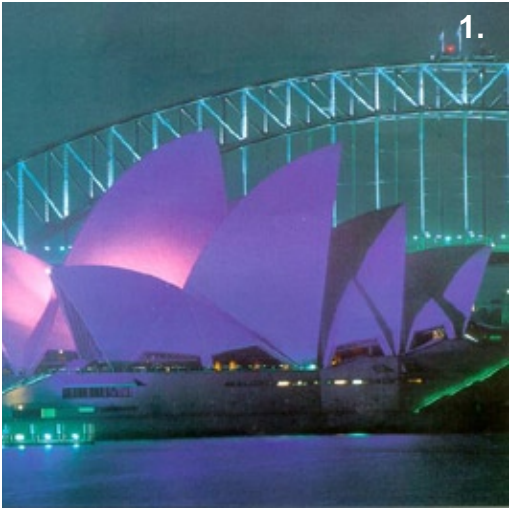


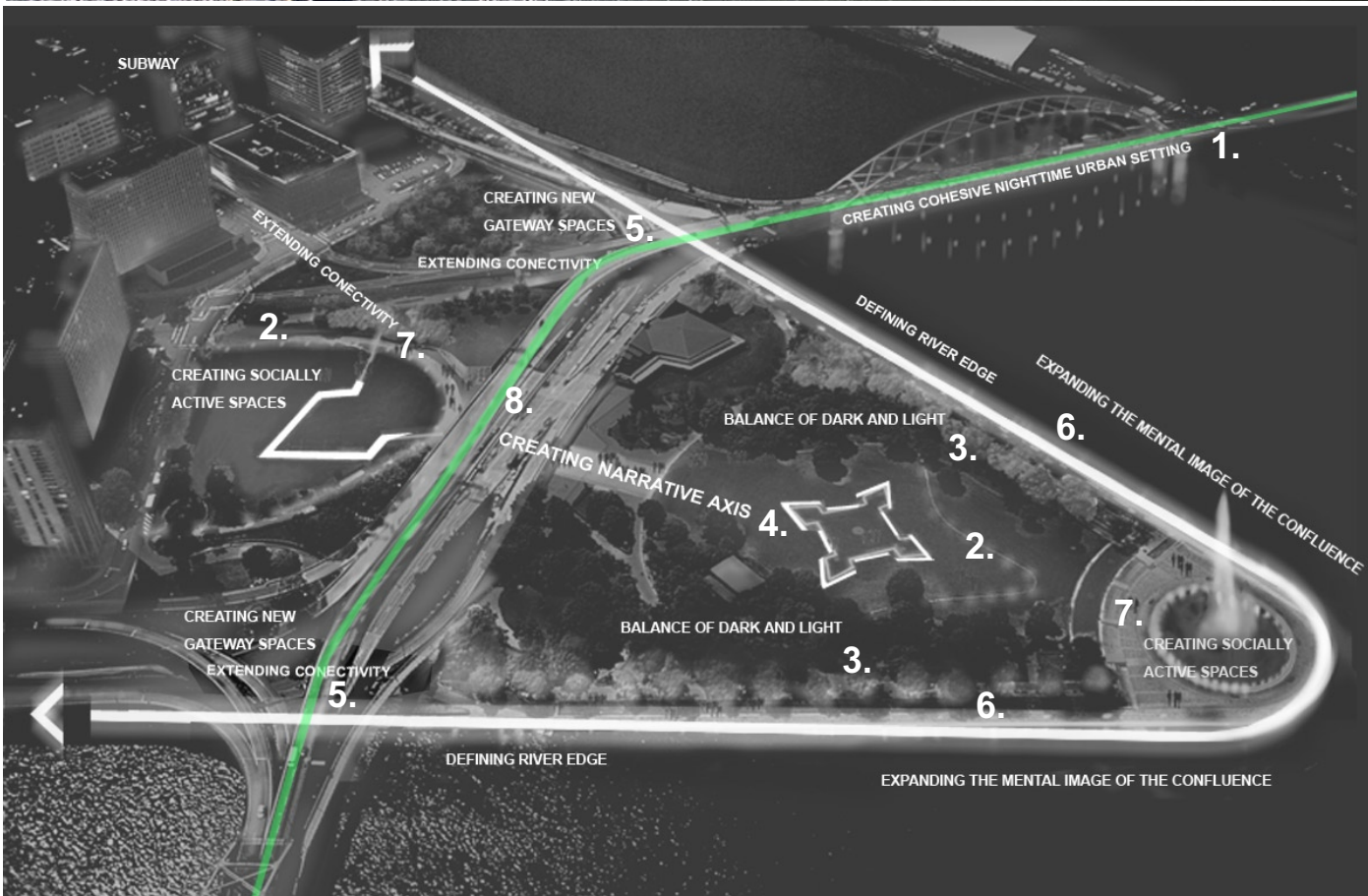
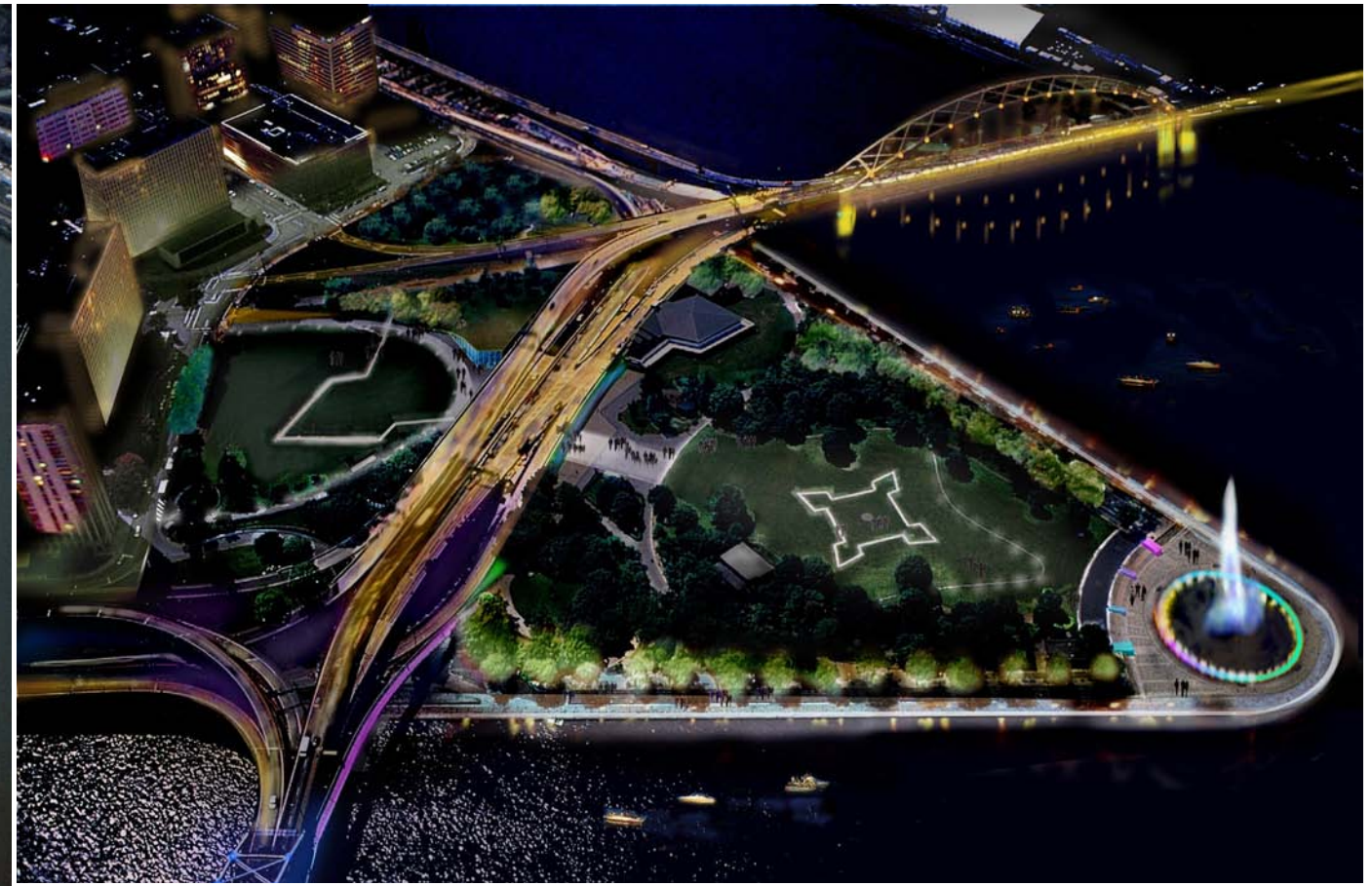
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Examples of using color light to transform large structures

1. Sydney Opera House
2. Elevated highway, Miami FL
3. Harbour edge, Holland



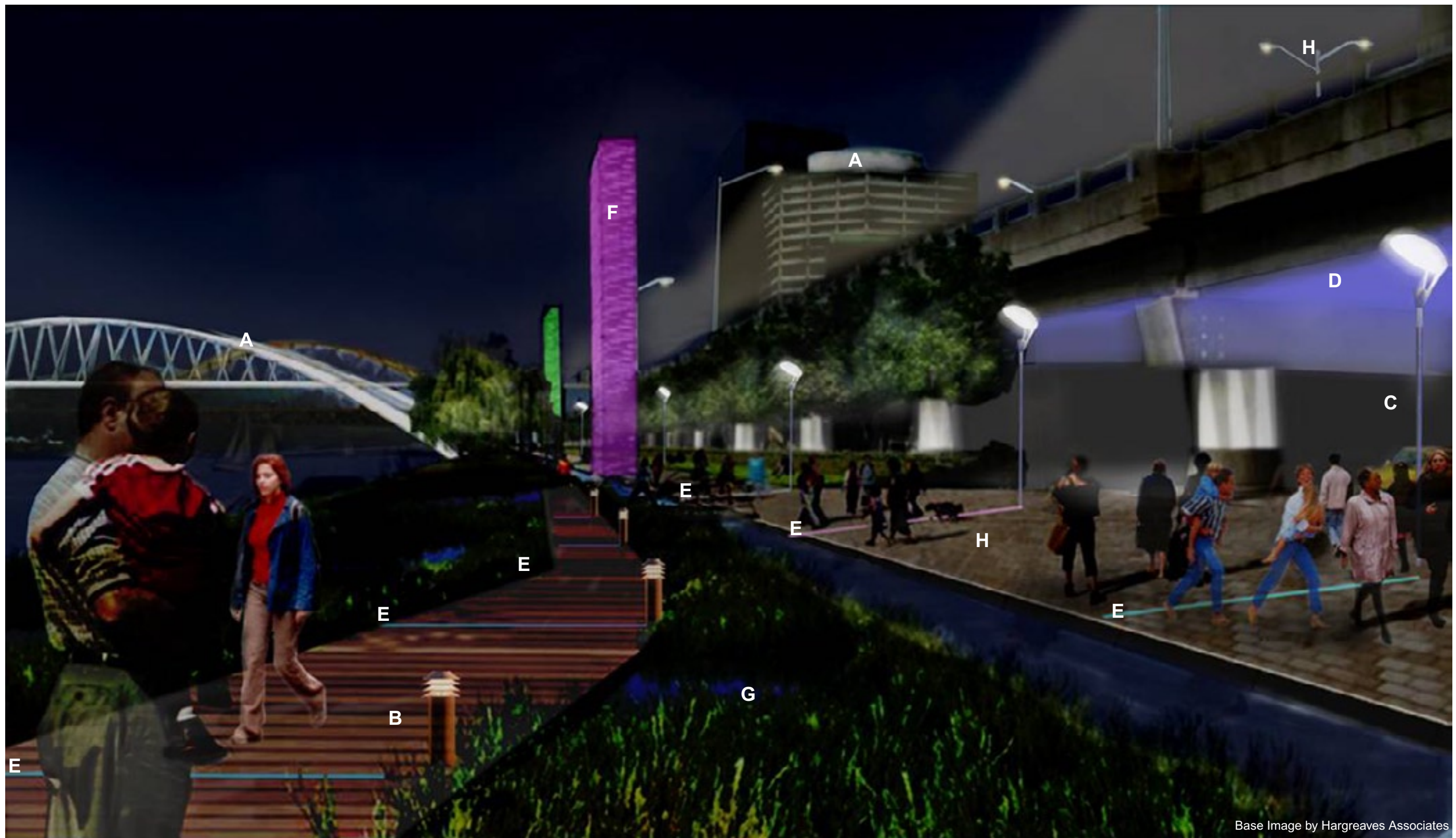


Responding to key projects

The full implementation of the Three Rivers Park could take a couple of decades. Within this time frame projects such as Point State Park and Mon Wharf could become a powerful way of advocating in the public mind the role lighting can play not only in making the rivers and their shorelines inspirational but also in the delivery of the related economic/social benefits.

Lighting clearly has a defining role to play in the development of these projects, as well as in the broad reintegration of these spaces into the fabric of the inner city core. As a response to the Point State Park comprehensive Master Plan to Pressley associates the lighting designs for this public realm space need to focus on:

1. creating a cohesive visual night time setting
2. providing a legible night time distinction between recreationally active and passive areas of the park
3. achieving a psychologically reassuring balance between lit and unlit areas
4. creating a narrative axis linking the main historical references of the park
5. creating new gateway spaces through the application of color light to add orientation
6. defining the river edge with white light and thus extending the visual impact of the confluence
7. creating a clear night time legibility of primary and secondary circulation routes
8. reducing the visual impact of the elevated highway system



Base Image by Hargreaves Associates

The Mon Wharf lighting design will need to develop a clear hierarchy of lighting addressing the physical transition from the river edge walkway (B) through the ecological/landscape areas (G) to the main circulation route (H). This hierarchy of for example of low level lighting bollards (B) and pole top luminaires (C) will need to also be a response to the undercroft of the raised highway (D) and to the down town city core beyond. The overall compositional nighttime effect of Mon Wharf will need to harmonise with the lighting of the surrounding city (A) and conversely the adjoining highway lighting (G) will need to harmonise with the lit environment of Mon Wharf.

All principal circulation routes will need to have defined progressional legibility (E) with clearly marked exit and entry points.

The features of the new landscape/urban design (F) as well as the existing elevated highway (D) could be lit as colorful, creative displays as a part of turning Mon Wharf into a vibrant nighttime destination space.



21st century Science Sport Arts Square

The section of the riverfront represents an important strategic boundary between the Carnegie Science Centre **(A)** and Heinz Arena **(B)** and extensive private sector led developments towards the West End bridge. A substantive new square **(C)** could be developed at this location by flattening the existing topology and by extending the space over the water edge.

Such a space would provide an inclusive and attractive destination in Three Rivers Park - a venue for large civic celebrations where people can meet, perform and relax. The design of the square balances green sustainability with information and interactive technologies extending the educational role of the Carnegie Science Centre into the public domain.

The new square would include multimedia beacons and would be located on a floorscape of LED lights capable of interactively reacting to people's presence. All of the electricity required for the multimedia installations would be supplied by the wind turbines **(D)** and an array of photovoltaic panels **(E)**. The lighting of the square would gradually change in character into low level lighting in response to the two ecological land/aquatic zones of Three Rivers Park.

(F).



21st century Science Sport Arts Square

- (A) Laser gateway
- (B) Multimedia beacons animating the square with light as well as providing a wide range of text, sound and image based information on the arts, sports and activities of the Carnegie Science Center
- (C) LED lit floorscape capable of interactively reacting to peoples movements across the square



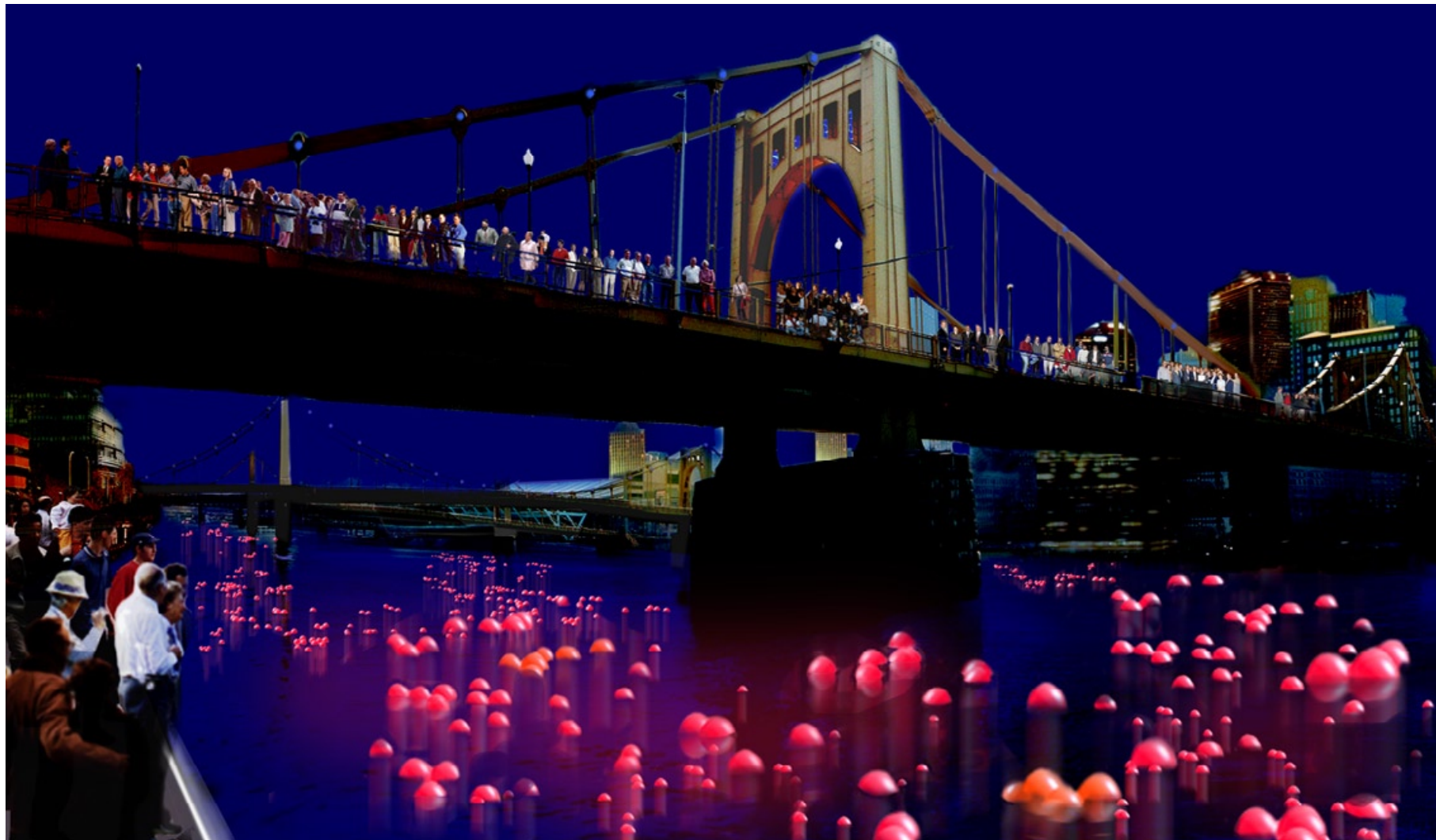
10th street bypass as a location of a Weekend Fair

Winning back public space

The Three Rivers Park has the potential for many unique urban spaces - many created by transport infrastructure. Freeing some of the highway space on a temporary basis with innovative programming and creative use of light could be realized with a minimal investment. The 10th street bypass could be transformed into a dual public realm space – a road during weekdays and a “linear square” at weekends. To be able to support nighttime uses, such as occasional carnivals and fairs the spaces would need to incorporate improved public lighting and a primary power distribution points.



Example of a temporary transformation of a river embankment road into a public beach Location: Paris, France



The Rivers of Light

A temporary event would attract and involve a large audience. The event would involve floating one thousand polycarbonate spheres with internally fitted pulsing lights down the Allegheny and Monogahela rivers. The spheres would be caught and removed once they pass the confluence.

The spectacle of the River of light could be also used to promote Pittsburgh by sending it to River Festivals in other cities.



Lighting in the context of cultural celebration

The creative use of light provides a unique platform for both public art projects as well as cultural programming within the Three Rivers Park. This could recreate a link to Pittsburgh long tradition of being fascinated with light in all its forms from big displays such the Marking the Light's Golden Jubille in 1929 (illustration1) to the association of Pittsburgh industrialist George Westinghouse with the inventor Nicholas Tesla.

The linking of the arts with the medium of light in all its manifestations could produce a basis for a programming unique to the Three Rivers Park and Pittsburgh in scale, form and content. Key events will need to be developed to anchor the program in central hubs of activity, with satellite events taking place along the rivers, on the water and other parts of the city. The projects and events ought to advocate a positive atmosphere focusing on a view of Three Rivers Park as a lively and unique cultural destination - a part of a creative and livable city.

The synergy of the Lighting Strategy and the proposed art programming would develop the importance of a creative approach to lighting within the area of Three Rivers Park in attracting people to the various areas along the three converging rivers. The events, public art projects and festivals would use light as medium and theme and connect with the Lighting Strategy.

These Events and Festivals need to support a sense of community and a unique civic identity and should be accessible to a multi-layered constituency if they are to succeed in attracting significant numbers of people to the Three Rivers Park. New audiences beyond the art world at times exclusive community need to be induced. The new audience creation will depend on programming capable of advocating a positive atmosphere with



the focus on the image of the Three Rivers Park and Pittsburgh as a lively and cultural place. Equally important is the process of raising people's critical expectations through enjoyment and active participation. Events, temporary projects and festivals involving various art institutions and schools, neighbourhood, cultural and community centres, would be an effective way to accomplish this.

Example of a riverborne community driven light based art event:

O Degrees
Date: 1998 Location: London Audience: 20,000
Budget: 350,000 \$

In early May the stretch of the Thames under the Greenwich Meridian became the setting for a monumental one night performance that developed the notion of making the invisible visible. This large scale event which was seen by twenty thousand people on the night explored the poetic, social and historical connotations of the Meridian. The realisation involved a flotilla of 60 boats and barges with monumental special effects and aerial pyrotechnics accompanied the choreographed sound performance.

Over five hundred local young people were directly involved in the creation of the event as well as 150 artists.

The project was a winner of the Callouste Gulbenkian big event production award as well as receiving funding from LAB, Arts Council and sponsors.

2. concept drawing for the event by Art2architecture
3. Fire effect on a barge
4. Light projection on a water screen formed by the London Fire Brigade Boat



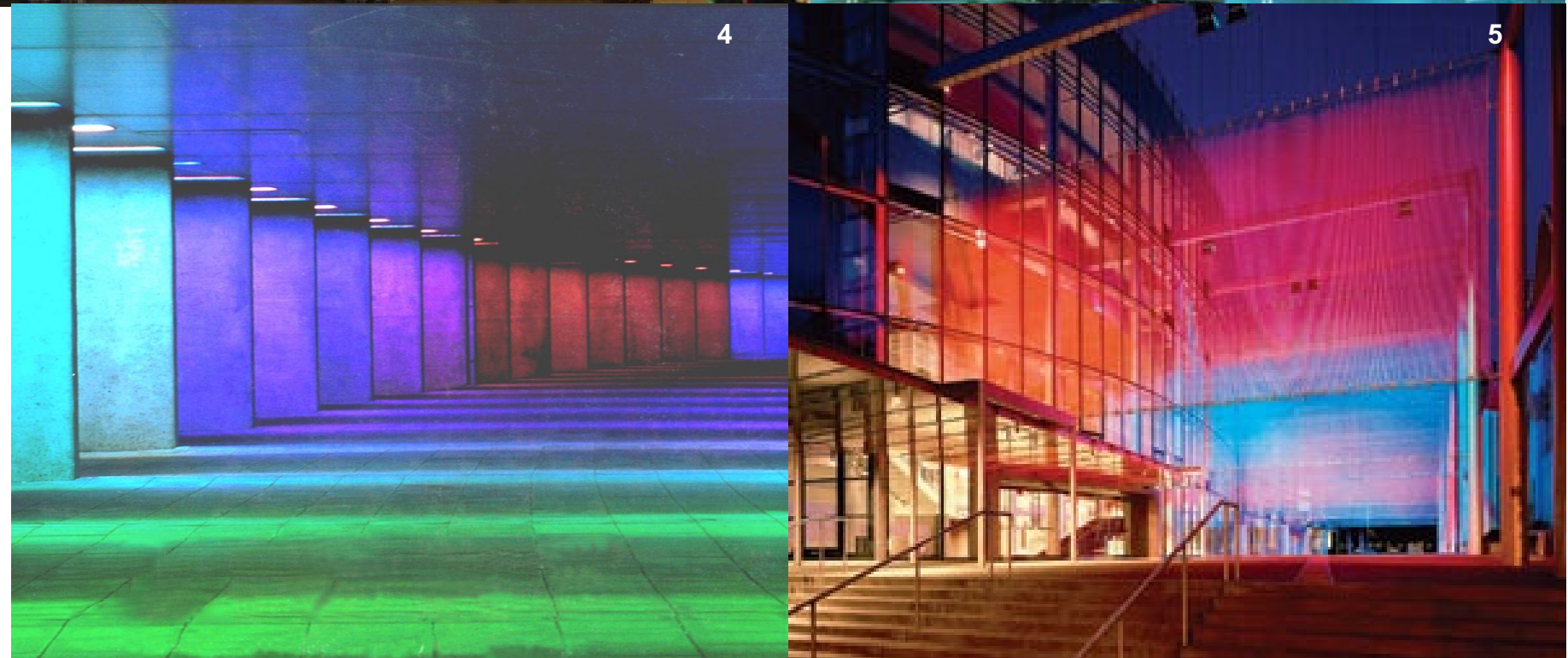


Lighting as a creative statement

Pittsburgh Cultural Trust's inspired idea that light as a medium could be a theme that would permeate the Cultural District and help define it in space and time, led to Robert Wilson and Richard Gluckman's "Sign of Light" and "Lightwall." (illustration1) Erwin Redl's "Flow" on the side of the Wood Street "T" station inspired by Pittsburgh's flowing three rivers (illustration 2), the Carnegie Science Center's light cone, Mellon Bank's experiment with high-intensity projecting beams of light from the top of its Grant Street headquarters onto the dome of Mellon Arena, the UPMC Sports Medicine Center's projections of footballs, baseballs and basketballs on the side of its practice center and finally the annual Pittsburgh Light Up Night are all examples of 'light' as an emerging creative theme in Pittsburgh.

The Three Rivers Arts Festival initiated collaborations with Pittsburgh filmmakers to present video and photography installations in empty storefronts along Liberty and Penn Avenues showcasing the work of emerging new media artists arts in non-traditional spaces. The public arts programming could explore the use of IT/ media technology to produce dynamic new environments, representing the convergence of place, story and media interpretation.

Similarly to Lyon Three Rivers Park could become a showcase of creative use of light as well as of worldwide excellence of design. The water taxi landings, undersides of bridges and the key gateway spaces could be identified as sites for creative lighting. Proposals could be solicited for light based artworks either through open or limited competitions or by direct invitation.



- 3 Tower of Wind Yokohama Japan by Toyo Ito programatic lighting installation on a 120' high ventilation shaft
- 4 Public art project Rotterdam Holland by Peter Struycken Light transformation of an underside of a elevated highway
- 5 Public art project by Leni Schwendinger Seattle Center programatic lighting installation on mesh screens
- 6. 7 Public art projects in the UK by Peter Freeman Light beacons

This section is intended as a guide for the implementation of lighting schemes to ensure that the completed installations will meet agreed design criteria and the broader objectives of the strategy.

When a competition brief for a lighting project in Three Rivers Park is written or client brief is issued to a lighting designer the starting point for any lighting project should first be the decision of whether or not to light an area or an object at night. During the day, under natural light everything within a scene will be illuminated and the canopy of the sky appears bright. At night the sky is dark and the contrast between illuminated and non-illuminated areas is pronounced. Clearly no attempt can be made to light everything in sight, so lighting priorities need to be established.

What should be lit and how? Should the whole area be illuminated or only a part?

The lighting design process will also be influenced at the brief stage by the consideration of:

- the function of the lighting- Is the lighting being provided for safety and security, or is it decorative?

Once these decisions are made the form of the lighting can be established by the lighting designers.

Selecting the correct lighting for the purpose will determine the direct energy usage, the spill of light past the target and the daytime appearance of the installation.

a. Sustainability

At its heart, sustainability ensures a better quality of life for everyone, now and for generations to come.

A widely used international definition of sustainability is “... *development which meets the needs of the present without compromising the ability of future generations to meet their own needs*”¹.

“United Nations Department of Economic & Social Affairs, Division for Sustainable Development.”

In terms of exterior lighting, sustainability issues primarily relate to the prudent use of natural resources and the protection of the natural environment.

The environmental impact of exterior lighting needs to be considered at the very beginning of the design process.

b. Environmental Effects

There are a number of environmental factors to be considered in relation to exterior lighting. These include direct energy use, visual

impact, light spill and light pollution and the effects on flora and fauna.

c. Ecology

An assessment of the ecological impact of artificial lighting needs to be considered as part of a broader assessment of the ecological impact of a particular development on for example the sleeping or roosting habits of local wildlife.

Establishing new trails on the river front may also disturb important natural habitats by the alteration of “buffer land” or by disturbing routes that link existing sleeping or roosting areas to feeding grounds.

Another environmental issue to be considered is that increased 24/7 recreational uses of the trail may place surrounding and nearby flora and fauna habitats under increasing pressure from the presence of man. This alone can have a number of adverse effects on the natural environment, including the disturbance of animals, the physical destruction of ground flora by walking and bike riding and the increased risk of accidents, such as fire, which may lead to major habitat destruction.

The proposals for lighting of the river edges and the bridges, in particular, may affect those species which depend on the river, such a freshwater fish and water birds. Aquatic ecosystems should also be considered as part of any environmental impact assessment in Three Rivers Park.

d. Direct Energy Use

Since 1850, the energy consumption of the United States has risen by a factor of 33. On average, each individual now consumes three times as much energy as in 1850 and there are eleven times more individuals in the country.

As outdoor lighting in urban areas such as Pittsburgh increases, it is important that some control is kept on its application.

The use of high-efficacy lamps in the external environment should be promoted by Three Rivers Park lighting strategy. This includes metal halide lamps, high-pressure sodium lamps, fluorescent and compact fluorescent light sources. The use of incandescent light sources should be discouraged and avoided wherever possible in Three Rivers Park.

The widespread application of energy efficient discharge or fluorescent light sources (at approximately 80 lumens per watt) rather than incandescent light sources (at up to 20 lumens per watt) should minimise direct energy consumption.

The use of optically efficient luminaires that direct light onto to

the required area with minimal light spill is a part of good lighting practice. Reflectors, louvers, cowls and other beam shaping accessories should be used to contain and control the light emitted by a lamp.

It is also important not to over light buildings and areas. Illuminance levels should not exceed Illuminating Engineering Society of North America (IESNA) recommendations. Similarly, the surface brightness (luminance) of buildings and spaces should be controlled, in accordance with the internationally accepted guidelines.

Specific levels of luminance can be related to an accepted classification of environmental zones. The Commission Internationale de l’Eclairage (CIE) has defined these zones as follows:

- E1 – “National Parks”, “Areas of Outstanding Natural Beauty” or other “dark landscapes”
- E2 – “Areas of “low district brightness” e.g. in rural locations but outside of Zone E1.
- E3 – Areas of “medium district brightness” e.g. in an urban situation.
- E4 – Areas of “high district brightness” e.g. an urban center with a high level of night time activity.

Brightness limitations for exterior lighting and signage should relate to these environmental zones, since the environmental zone will usually define the overall district brightness (See Table 3.1). A high standard of aesthetic design in combination with high efficacy light sources, efficient luminaires with optical control and adherence to the guidelines for recommended luminance and illuminance values should prevent excessive energy use in Three Rivers Park.

| Table 3.1 Obtrusive light limitations for exterior lighting installations in Three Rivers Park. | | | | | | |
|--|------------------------------|--------------------------------|-----------------|---------------------------|-----------------|--|
| Zone | Sky Glow ULOR (Max. %) | Light into windows Ev (lux) | | Source Intensity* Kicd | | Building Luminance** L (cd/m2) Average before curfew |
| | | Before Curfew | After Curfew | Before Curfew | After Curfew | |
| E1 | 0% | 2 | 1*** | 0 | 0 | 0 |
| E2 | 5% | 5 | 1 | 50 | 0.5 | 5 |
| E3 | 15% | 10 | 5 | 100 | 1.0 | 10 |
| E4 | 25% | 25 | 10 | 100 | 2.5 | 25 |

Notes

UW/LR (upward light ratio) is the maximum permitted percentage of flux that goes into the sky.

Ev is vertical illuminance.

I is light intensity measured in candelas (cd).

L is luminance (surface brightness) measured in candelas per square metre (cd/m2)

* Source intensity applies to each light source when viewed from the potentially obtrusive direction, outside the area being illuminated.

This figure is for general guidance only. For sports lighting installations such as the Steeler’s Heinz Field and the Pirate’s PNC Park it may be possible to achieve.

** Building luminance should be limited to avoid over lighting. Luminances should relate to district brightness, hence environmental zone.

*** Acceptable from public road lighting installations only.

e. Embodied Energy of the Installation

Embodied energy is the energy consumed by all of the processes associated with the manufacturer of a product (both a physical entity or a service) from the acquisition of natural resources to product delivery. This includes the mining and manufacturing of materials and equipment, the transport of the materials and the administrative functions. Embodied energy is a significant component of the lifecycle impact of any product.

The production of this energy, primarily electricity from coal-fired power stations, is responsible for much of the United State's greenhouse gas emissions.

The importance of embodied energy and other environmental impacts does not become apparent until materials from the life cycle of a product are examined in detail. This is known as Life Cycle Assessment (LCA).

A Life Cycle Assessment examines the total environmental impact of a material or product through every step of its life - from obtaining raw materials (for example, through mining or logging) all the way through manufacture, transport to a store, using it in the home and disposal or recycling. LCA can consider a range of environmental impacts such as resource depletion, energy and water use, greenhouse emissions, waste generation and so on. LCA can be applied to a whole product (a luminaire or lighting installation) or to an individual element or process included in that product. It is necessarily complex and the details are beyond the scope of the lighting strategy. An internationally agreed standard (ISO 14040) defines standard LCA methodologies and protocols.

f. Visual Impact

The appearance of lighting equipment during the daytime can have an adverse effect on the environment. For example, floodlighting gantries at sports grounds and lighting columns on roads and highways can have a significant impact on local views. Lighting equipment mounted on building facades without due consideration of the architecture can be ugly and unsightly.

Where towers, masts or parapet fixings are likely to be viewed against an open sky or a particularly attractive panorama, and protective painting of the luminaires and lighting equipment should be light in colour and selected with a view to camouflaging the luminaires against the background of the sky.

In the landscape, creative ways of concealing luminaires and control gear housings in a natural way, utilizing trenches, low level planting, trees, low fences and walls should be considered. If concealment of the luminaires is not practical, locations should be chosen that reduce the daytime impact of the luminaires. The locations of electrical equipment such as distribution boxes and supply pillars should be selected with care, to ensure that equipment is concealed

from most normal viewing angles.

g. Light Spill & Light Pollution

The use of exterior artificial lighting can cause light pollution. Light pollution principally occurs as sky glow, light trespass and glare.

In September 2002, the 2nd European Symposium on the Night Sky took place in Lucerne, Switzerland. The attendees unanimously requested all European Governments and the European Union to take immediate action to control light pollution. Legislation against light pollution has since been adopted in the Czech Republic and Lombardy, Italy.

Direct upward light from exterior lighting installations causes sky glow. This is the orange glow that can be seen for miles around urban areas, caused by sodium lighting scattered by water droplets and dust in the atmosphere. It is particularly noticeable on the urban fringe.

Glare is caused by the uncomfortable brightness of a light source viewed against a darker background. The Illuminating Engineering Society of North America (IESNA) defines glare as follows:

“Disability Glare (veiling luminance) is caused by stray light scattered within the eye, which reduces the contrast of the primary image on the retina. This contrast can be thought of as a “veil” of luminance over the objects...Glare from streetlights, pedestrian lights, floodlights and landscape lights all contribute to veiling luminance, as do extremely bright surfaces”

“Discomfort glare does not necessarily reduce the ability to see an object (as is the case with disability glare) but it produces a sensation of discomfort...Discomfort glare can be reduced by decreasing the luminance of a light source, or by increasing the background luminance around the source.”

“Nuisance or annoyance glare has not been quantified, although research is ongoing.... For now, it may be defined as glare that causes complaints, such as the “light shining in my window” phenomenon.” IESNA Recommended practice Guide: Lighting For Exterior Environments, 1999.

Light trespass is defined as light spilling beyond the boundary of a property or area to be illuminated. There are three principal measures that can be taken against light pollution:

1. Ensure that all exterior luminaires are designed and installed to ensure that light is emitted in a downward direction, rather than horizontally or upwards.
2. Ensure that only the correct amount of light is provided. Overlighting is the cause of much light pollution.
3. Switch off exterior lighting when it is not required.

h. Environmental Initiatives in the USA

In the United States, the LEED (Leadership in Energy and Environmental Design) Standard has been created to define green building by establishing a common standard of measurement, promote integrated, whole-building design practices and recognise environmental leadership in the building industry. With reference to lighting, the principal requirement is for all lighting installations to avoid light pollution.

The following points are extracted from the LEED Standard rating system:

“Credit 8...Light Pollution Reduction Intent Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments. Requirement Credit 8.0 (1 point) Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting For Exterior Environments, AND design interior and exterior lighting such that zero direct-beam illumination leaves the building site. Technologies & Strategies Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimise site lighting where possible and model the site lighting using a computer model. Technologies to reduce light pollution include full cut off luminaires, low reflectance surfaces and low angles spotlights”

i. Reducing Crime and Fear of Crime

Carefully applied exterior lighting can also have a positive effect on the environment. It can instil a feeling of civic pride and have an affect perceived and actual safety.

One recent study found that “...improved street lighting led to significant reductions in crime...with an overall reduction in recorded crime of 20% across all the experiment areas...”

UK Home Office Research Study 251 “Effects of improved street lighting on crime: a systematic review” August 2002

Fear of crime and, to a much lesser extent crime itself, can deter people, not just vulnerable groups, from using even good quality public spaces.

When assessed, the expenditure on good lighting in a public realm is more effective in terms of increased safety than equal expenditure on closed circuit television systems and security cameras.

In the United States, a study carried out by Lewis & Sullivan (1979) in Fort Worth Texas found that improved street lighting in a high crime residential neighborhood significantly reduced the crime rate within 12 months. The source of the data was local police records before and after the installation. A similar study carried out by Quinet & Nunn (1998) in Indianapolis, Indiana improved street lighting in combination with local police initiatives, significantly reduced calls for police service for violent and property crime also over a six to nine month period.

Design Principles

Exterior lighting within Three Rivers Park should promote safety and security and enhance appreciation and enjoyment of the surroundings for everyone.

Adequate and properly distributed light of a suitable color is needed to display the form and characteristics of principal features of the outdoor environment in a satisfying manner, to reveal hazards such as changes in level, illuminate dark and potentially dangerous areas and enable full advantage to be taken of the opportunities for entertainment and leisure after dark.

Often a small amount of light can fulfill these needs. The outdoor environment is often spoiled by an excess of mis-directed artificial lighting. A suitable balance between the various illuminated areas in a given scene is usually a matter of subjective judgment rather than engineering expertise. An understanding of the potential lit effect is required both on a large scale and in relation to individual buildings and features. Lighting calculations should therefore be subservient to aesthetic judgment and professional lighting experience when dealing with most of the proposed lighting within Three Rivers Park.

In approaching the detailed design of a scheme, the designer's first task should be to identify the objectives of the proposed lighting installation and consider how these can be met by applying the design parameters identified within the lighting strategy. The best results will be achieved when individual schemes within a district are co-coordinated together by the same team of professionals.

In all instances, the Riverlife Lighting Committee should monitor progress to ensure that the agreed objectives of the lighting strategy are strictly adhered to.

Aesthetic Considerations:

Structure:

Unity between various lighting elements can be achieved with a carefully conceived design theme. Use of the lighting strategy should guide the development of the overall lit effect and the selection of appropriate luminaires.

Key:

A high key scene will have many bright tones and relatively high levels of illuminance evenly distributed. A low-key scene will have mainly dark tones and intentional variations in illuminance giving areas of light and shade. In Three Rivers Park, the high key zones will be the active areas of the downtown riverfront such as Mon Wharf, the proposed 10th Street pedestrian area, all of the bridges, the Proposed Science Center Square and the river landings. Trails, boardwalks and boulevards can be generally classified as more passive and low key.

Scale:

In lighting terms, this relates to perceived size of structures, buildings and spaces relative to other forms and to people when viewed at night. Artificial lighting can be very selective and the interpretation of scale can be a positive influence on the lighting design. For example, an intimate and friendly scale can be created by controlled contrasts in luminance and pools of light.

The more diffuse and general the lighting is, the easier it will be to assess the relative scale of objects and structures. A building that has only selected features illuminated can appear to have a smaller mass than the same building completely washed with light.

Effectiveness in the manipulation of scale depends on the relationships created between illuminated objects within the overall scene.

Rhythm:

The spacing of individual illuminated elements, such as luminaires, lighting columns and pools of light are perceived as rhythms. Wider spacings between luminaires and lit surfaces will elicit a subdued response from the viewer. Festive lighting for example generally uses faster more complex rhythms composed of smaller lighting elements spaced at shorter intervals. An awareness of the rhythms created by artificial lighting should be considered during design development.

Emphasis:

Selective lighting can enhance attractive features and conceal unattractive ones. The surface texture and form of an object can also be revealed by the careful placement of luminaires. The degree of emphasis achieved will depend on the individual location and the ambient lighting conditions.

Modeling:

It is the luminous intensity and direction of light in relation to the form and texture of a lit surface, combined with the viewing angle that creates the highlights and shadows that give life to a scene. Dramatic effects can be achieved by angling floodlights at glancing angles to produce string shadows. Modeling can be completely lost when the viewing angle is the same as angle of the incident light. These are entirely subjective impressions that cannot be quantified in engineering terms. Lighting trials are often a good way to assess this type of effect.

Enclosure:

Illuminated vertical surfaces will contribute strongly to the sense of enclosure in the outdoor environment. When lighting vertical surfaces it is important to consider the continuity with other spaces and connected surfaces, both physically and visually.

Sequence & Direction:

Continuing interest can be maintained by drawing people through a sequence of spaces with variations in the lit effect. For example moderately lit trails and boulevards will lead into a more brightly lit square with floodlit buildings around the perimeter. Pedestrians can be guided along the desired route by using marker lights or an “iconic” luminaire style such as the “indirect” pole top luminaires proposed for the trails.

Depth:

Apparent distance can be increased or reduced by the careful application of artificial lighting. An informal, irregular arrangement of illuminated surfaces can create increased depth in the landscape. Regular arrangements will make it easier to perceive distances. The use of silhouetting can also change the apparent relationship of objects within the field of view at night.

Color:

There are two aspects of to consider when discussing most artificial lighting - color appearance and color rendering.

The color appearance of a light source or illuminated surface will be seen as either “warm” or “cool”. Lamps with a low correlated color temperature are “warm” and those with a high correlated color temperature are “cool”. This has nothing to do with the ability of a light source to render colors accurately, which is separately defined as “color rendering”. Light sources with a high color-rendering index (Ra) are the closest to natural daylight in their ability to accurately render surface colors.

The use of saturated colored light is an important part of the Three Rivers Park lighting strategy. It is being utilized to create a unique identity and enhanced sense of place for Pittsburgh. However, it is widely acknowledged that insensitive or inappropriate use of colored lighting in the external environment can cause great dissatisfaction. Whilst the use of saturated colored light is definitely suitable for the more active areas of the riverfront and downtown Pittsburgh, it would be entirely inappropriate for quieter sections of the trail and the urban fringe.

Visual Appearance:

There is a marked difference in appearance between the daylight appearance of landscapes and structures and their appearance when artificially illuminated at night.

There is a different order of contrast between objects seen against the dark canvas of the night sky compared with the relatively uniform luminance of the sky during the day. The general direction and distribution of light are usually completely reversed at night.

The relationship between different objects within a night scene can be altered through selective artificial lighting.

When not concealed from most normal viewing angles, the daytime appearance of lighting equipment must be made acceptable. Sometimes, this will influence the spacing, height and design of lighting columns, to maintain the scale and visual quality of the environment, both day and night. There will also be instances where it is preferable to mount street lighting onto buildings and structures rather than introduce visually intrusive lighting mounted on columns or gantries in a particular area.

Technical Criteria

For functional and amenity lighting, the standards and design guidelines set by the American National Standards Institute (ANSI) out and the Illuminating Engineering Society of North America (IESNA) should be used. This will ensure the lighting level is appropriate to the task. The following table is reproduced from the IESNA Recommended Practice Guide “Lighting for Exterior Environments” 1999 (permission pending).

Adherence to recommended brightness and contrast criteria is important to the success and overall integration of the lighting strategy.

Brightness & Contrast:

Too much light is frequently projected onto buildings, destroying any appreciation of the architecture. Lower light levels can often be more revealing and sympathetic. Planning regulations often limit the brightness of advertising signs, but not the surface brightness of lit buildings. Careful consideration of surface brightness and contrast is essential to a successful lighting scheme.

There are two concepts of brightness: objective and subjective. Objective brightness is the measurable brightness of a surface described in candelas per square meter (cd/m2). Subjective brightness is the effect that is experienced by the observer and it depends on the objective brightness, the size of the area emitting light, the brightness of the surroundings and the position of the viewer in relation to the object.

Therefore, working samples of proposed luminaire types should always be seen and approved before equipment is finally chosen. Ideally, an on-site lighting trail should take place before any final

There are two principal quality aspects to consider when selecting exterior lighting equipment, build quality and optical performance:

Build quality:

All exterior luminaires need to be robust, particularly in the “marine” environment of the Three Rivers Park.

Exterior luminaires are classified according to the degree of protection against the ingress of water, dust and solid objects.

Ingress Protection (IP Rating):

IP is an acronym for Ingress Protection. The IP ratings are arrived at as a result of the ingress protection tests specified in IEC 529: 1989 which equates to European Standard EN 60529: 1992. This standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. The object of the standard is to give protection to persons against access to hazardous parts inside the enclosure: protection of the equipment inside the enclosure against ingress of solid foreign objects and protection of the equipment inside the enclosure against harmful effects due to the ingress of water or other liquids. The letters IP are followed by two numerals. Luminaires installed into an exterior environment should be a minimum of IP44 (under canopies). A higher IP rating will provide increased protection and therefore less frequent cleaning will be required. See Table 2.1

Optical performance:

Specifying the best constructed exterior quality luminaire does not guarantee the best lighting performance. It is also difficult to assess the optical performance of luminaires from manufacturers published data. Different luminaires can appear to be equivalent on the basis of catalogue information, but when viewed side-by-side, any differences in optical performance will become apparent. Therefore, working samples of proposed luminaire types should always be seen and approved before equipment is finally chosen. Ideally, an on-site lighting trail should take place before any final decisions are made.

| TABLE 2.1: INGRESS PROTECTION — IP CODES | | |
|---|---|-------------------------------------|
| FIRST NUMERAL | | SECOND NUMERAL |
| PROTECTION AGAINST SOLID BODIES | PROTECTION OF PERSONS AGAINST ACCESS | PROTECTION AGAINST LIQUIDS |
| X Protection unspecified (untested) | X Protection unspecified (untested) | X Protection unspecified (untested) |
| 0 No protection | 0 No special protection provided | 0 No protection |
| 1 Objects > 50mm | 1 Protection of hand against access to dangerous parts | 1 Vertically dripping water |
| 2 Objects > 12mm | 2 Protection of fingers against access to dangerous parts | 2 75–90° angled dripping water |
| 3 Objects > 2.5mm | | 3 Sprayed water |
| 4 Objects > 1.0mm | | 4 Splashed water |
| 5 Dust protected* | | 5 Water jets |
| 6 Dust tight | | 6 Powerful water jets |
| | | 7 Temporary immersion |
| | | 8 Continuous immersion |

Recommended Light Sources

The choice of an appropriate light source is a critical part of the lighting design process. The number of light sources available to the designer is constantly changing, with new types continually being produced.

There are five factors to be taken into consideration when selecting an appropriate light source:

Efficacy

The output of the lamp in relation to its energy usage, measured in lumens per Watt. This is often the principle consideration for reasons of economy.

Lamp Life

The average life of a lamp in a large installation. Figure quoted by lamp manufacturers are to '50% failure'. Lamp life has a significant impact on maintenance costs.

Colour Appearance

An assessment of what the colour of the light source appears to be. This is important in considering the overall effect of the lighting.

Colour Rendering

The ability of the light source to render colours accurately. Although less important in exterior lighting, poor colour rendering can have a deadening effect on an area. Good colour rendering light source have Ra >80 or below to Group 1A, 1B or 2A.

Lamp Shape and Coating

The shape of a light source will dictate much of the luminaire design.

A phosphor coating will change the quality of the light.

Recent developments in metal halide lamps, particularly with ceramic arc tubes (CDM), have now made the use of white light a viable alternative to yellow high-pressure sodium lighting in the external environment.

Ceramic metal halide (CDM) lamps are recommended as the principal light source for Three Rivers Park. CDM lamps give lumen outputs comparable to high-pressure sodium lamps (SON). CDM lamps also have a 12,000-hour life, and stable, accurate color rendering.

The difference in the relative efficacies of white light and yellow light means that it should be possible for greater night time visibility to be achieved with lower levels of illuminance from good color rendering white light sources. Recent research in the United States has found that at the levels of luminance found in subsidiary and residential roads there are substantial differences in the real efficacies of low-pressure sodium lamps (SOX) versus ceramic metal discharge lamps (CDM) due to the visual response of the human eye.

The researchers found that a relative multiplying factor of 2.3 to 1.7 times can be applied, when comparing good color rendering ceramic metal halide light sources with monochromatic low pressure sodium ones.

This means that a 35w SOX lamp producing 4800 lumens should really be down rated to 2800 lumens, when compared to ceramic metal halide lamps in the same application. This would make a 35W SOX lamp equivalent to a 35w ceramic metal discharge lamp in the same application.

The color of the light is another important factor. A full spectrum of white light enables all colors throughout the spectrum to be differentiated, whereas monochromatic low pressure sodium light allows only one color to be recognized.

- 1) The de-rating of sodium light flux caused by the biology of the human eye.
- 2) The very superior color rendering of ceramic metal discharge lamps
- 3) People intuitively prefer white light because it is closer to daylight.

There are, therefore, powerful arguments for considering ceramic metal discharge (CDM) lamps in preference to low-pressure sodium SOX or high-pressure sodium SON.

Lumen Depreciation and Lamp Mortality:

Over a period of time, the lumen output from any lamp will deteriorate. The rate of depreciation is dependent upon the type of lamp installed. When the lumen output has reduced to the extent that the lit effect is compromised or the illuminance levels of the installation falls below the minimum designed illuminance, re-lamping is required.

Similarly, the survival of lamps varies, over time, dependent upon the type of lamp used and the environment in which it is operated. Manufacturers usually quote "rated average" life hours. This is the time after which 50% of the lamps within a given installation can be expected to have failed. Some lamps will have failed prematurely and others will last much longer than the rated average life. For optimum efficiency, it is important that lamp replacement intervals should be at least equal to the rated average life hours of the installed lamp.

Lamp manufacturers can provide data that will enable lumen depreciation and lamp mortality to be properly assessed during the design phase of each project.

Lighting for Roads and Highways

In the United States, street lighting luminaires are classified by the way in which they can be mounted, by the luminous intensity distribution and by the amount of visual cut-off that they provide. The IESNA "Lighting Handbook" discusses the various luminaire distribution types in detail.

One classification of light distribution characteristics is the distance away from the carriageway that the luminaire is intended to be located. For example:

Type I luminaires are designed to be located over, or immediately adjacent to the road.

Type II luminaires have a greater setback than Type I, but less than Type III.

Type III luminaires have a greater setback than Type II, but less than Type IV.

Type VI luminaires have the greatest set back from the carriageway (i.e. the most asymmetric forward throw).

Type V luminaires have an axially symmetric light distribution that produces a circular pattern of illuminance.

Cut-off classifications are designated as follows by the IESNA:

Full Cut Off:

A luminaire light distribution where zero candela intensity occurs at 90 degrees above nadir and at all greater angles from nadir. Additionally, the candela per 1,000 lamp lumens (cd/klm) does not numerically exceed 100 (or 10 per cent) at a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.

Cut-Off:

A luminaire light distribution where the candela per 1,000 lamp lumens (cd/klm) does not exceed 25 (2,5 per cent) at an angle of 90 degrees above nadir and 100 (or 10 per cent) at a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.

Semi-Cut Off

A luminaire light distribution where the candela per 1,000 lamp lumens (cd/klm) does not numerically exceed 50 (5 per cent) at an angle of 90 degrees above nadir and 200 (or 20 per cent) at a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.

Non Cut-Off

A luminaire where there is no candela limitation in the zone above the maximum candela value. All new street lighting installations within Three Rivers Park should utilize full cut-off luminaires, to minimize light spill and to maximize optical efficiency.

Where possible, ceramic metal halide light sources should be utilized.

Existing Street Lighting

In addition to new projects, the effective implementation of Three Rivers Park lighting strategy will require the gradual implementation of “best practice” performance standards for the existing street lighting that are both energy efficient and optically effective.

In line with the broader visual aims of the strategy, it is proposed that street lighting in the immediate vicinity of Three Rivers Park should be converted from yellow (high pressure sodium) lighting to “white” or “blue-white” metal halide lighting.

Good color rendering white light in the nocturnal environment will reveal the natural form, size and color of objects. This will produce a more comfortable and attractive night time atmosphere, and enhance the perception of safety on the streets and boulevards. The human eye is also more sensitive to white light, allowing relatively lower levels of illumination to be used overall.

| Recommended IESNA Maintained Illuminance Levels for Floodlighting Buildings & Monuments | |
|---|---|
| Area Description | Average Target Vertical Illuminance (Footcandles) |
| Bright Surroundings and Light Surfaces | 5 |
| Bright Surroundings and Medium Light Surfaces | 7 |
| Bright surroundings and Dark Surfaces | 10 |
| Bright Surroundings and Light Surfaces | 2 |
| Dark Surroundings and Medium Light Surfaces | 3 |
| Dark Surroundings and Medium Dark Surfaces | 4 |
| Dark Surroundings and Dark Surfaces | 5 |

Metal halide lamps are also physically more compact than high-pressure sodium lamps. This means that they can be placed in an optimum relationship to a reflector profile for maximum optical efficiency.

Many of the existing sodium vapor lamps and semi-cut-off luminaires in Pittsburgh produce a high component of wasted light. Replacement of the existing luminaires with more efficient, full cut-off metal halide luminaires should be considered. For reasons of overall economy, existing high pressure sodium and mercury vapor lamps should not be discarded until they reach the end of their working life. The timetable for the conversion of existing street luminaires should be scheduled to take this into account.

| Recommended IESNA Maintained Illuminance Levels for Pedestrian Ways | | |
|---|---|---|
| Walkway and Bikeway Classification | Minimum Average Horizontal Illuminance Levels on Pavement (Footcandles) | Average Vertical Illuminance Levels For Special Pedestrian Security (Footcandles) |
| Sidewalks (Roadside) and Type A Bikeways | | |
| | | |
| Commercial Areas | 1 | 2 |
| Intermediate Areas | 0.5 | 1 |
| Residential Areas | 0.2 | 0.5 |
| | | |
| Walkways Distant from Roadways and Type B Bikeways | | |
| | | |
| Walkways and Bikeways | 0.5 | 0.5 |
| Pedestrian Stairways | 0.5 | 1 |
| Pedestrian Tunnels | 2 | 0.5 |

Lighting for Trails and Boulevards

As part of it’s medium to long-term implementation program, Three River’s Park should develop it’s own distinctive trail luminaire & generic post design.

When the initial development cost of custom luminaires is amortized over a significant number of units (400-500 pieces upwards) economies of scale can make the project affordable.

The city of Melbourne, Australia recently developed it’s own special lighting column designs. In terms of price, the city of Melbourne’s custom luminaires compare favorably with similar products available in the local market. The special luminaires are generally 10% cheaper than standard “off-the-shelf” items.

| Recommended IESNA Maintained Illuminance Levels for Pedestrian Ways | | |
|---|---|---|
| Walkway and Bikeway Classification | Minimum Average Horizontal Illuminance Levels on Pavement (Footcandles) | Average Vertical Illuminance Levels For Special Pedestrian Security (Footcandles) |
| Sidewalks (Roadside) and Type A Bikeways | | |
| | | |
| Commercial Areas | 1 | 2 |
| Intermediate Areas | 0.5 | 1 |
| Residential Areas | 0.2 | 0.5 |
| | | |
| Walkways Distant from Roadways and Type B Bikeways | | |
| | | |
| Walkways and Bikeways | 0.5 | 0.5 |
| Pedestrian Stairways | 0.5 | 1 |
| Pedestrian Tunnels | 2 | 0.5 |

Lighting for Trails and Boulevards contd/..

In 1990, the signature lanterns and poles now installed on Swanston Street, Melbourne cost \$7,000.00 to develop. Initial design development took over 100 hours and cost approximately \$9,000.00 US dollars. Ten years later, this luminaire design has been used extensively throughout the municipality. Amortized over 400 units, the design fees amounted to an additional \$17.50 per luminaire.

More recently in Melbourne, a special streetlight was developed for use along the major streets within the Hoddle Grid. By the end of year 2,000, a total of 136 luminaires had been installed. The initial design cost amortized over the just 136 units was just \$66.17 per luminaire. However, as more of the luminaires are installed throughout the city the design development costs reduce pro-rata.

Special luminaires should utilize standard commercially available components including reflectors, lamps control gear and sometimes poles. This will assist long-term maintenance and make the project viable.

A custom luminaire can also enable additional items such as telecommunications, security cameras, way finding and signage and other services to be easily accommodated. If detailed requirements are not known at the time of the design, provision can be made to accommodate additional services in the future.

The design of a special luminaire for the Three Rivers Park Trails would be an excellent opportunity for a design competition, with attractive sponsorship and public relations potential.

Techniques for the lighting of bridges

The way in which the bridges of Pittsburgh appear at night is of vital and symbolic importance to the overall character and quality of the night time environment of the Three Rivers Park.

The starting point for any detailed lighting design should be to develop a clear understanding of each bridge structure. The lighting must enhance the essential character of each bridge and to do this, all light sources must as far as possible be concealed from view. It is also important to avoid glare to persons either on the bridge itself or viewing the structure from a distance.

It is intended that all of the bridges should generally adopt a similar lighting vocabulary, to create a unified night time appearance.

The bridge decks should be strongly illuminated to strongly express the horizontal connection between bridge itself and the trails on both river banks. Generally, white light is proposed, either ceramic metal halide or linear fluorescent light sources should be used. The stone piers should be highlighted to reveal the texture of the masonry and ensure that the illuminated structure is grounded.

Large structures such as the Fort Duquesne and Fort Pitt Bridges need to be particularly sensitively lit, to ensure that the illuminated bridges do not diminish the scale and impact of Point State Park and the adjacent downtown area. It is proposed to emphasise the horizontal elements in preference to the large central arches.

Dark painted structures such as the Monongahela River Bridge and Fort Wayne Railroad bridges cannot be illuminated with projected light. In these instances it is proposed to delineate the essential structural elements with graphic lines of light.

Techniques for the lighting of structures

Ensure that where required, exterior lighting schemes are designed as an integral element of any new development, rather than as an afterthought. This means that lighting should be considered at a very early stage in the project planning.

Illuminate only buildings and structures of sufficient merit or where lighting enhances the ambience of the immediate surroundings. Take into account the existing illumination of adjacent buildings and have due regard for the total lighting effect on an area. Do not illuminate buildings or structures where residential amenities will be compromised by intrusive lighting.

Ensure that exterior lighting installations are discreet and do not compromise the architectural integrity of the host building or structure. It is also important to avoid visual clutter. Existing structures and buildings will require careful selection of product and containment methods to ensure that the visual appearance is acceptable when seen in the daytime. Luminaires should be installed with due regard to the fabric of the building itself. Careless installation of luminaires can exacerbate this problem. Contact between of different metals (both lighting equipment and structure) can cause electrolytic action and poor mechanical installation can cause cracking or failure of the surfaces onto which the luminaire is mounted.

Access for installation and daytime/night-time working is also a factor to be considered if the building or structure must be kept fully operational whilst the lighting is installed.

Ensure that the quality and intensity of the artificial lighting is appropriate for the physical characteristics and surface finish of the material being illuminated.

Lighting equipment locations should be chosen to achieve the best overall lighting effect. Often equipment positioned to light a particular feature does not do so, due to an inappropriate choice of luminaire and location. For example, it is common to see columns highlighted with wide beam, floodlights that cast most of their light through adjacent windows, instead of utilizing narrow beam luminaires at close offset that focus the light onto the column itself.

Luminaire locations should be concealed or as discreet as possible. The frequent use of large-scale floodlights often makes concealment impossible. It is preferable to select smaller more compact luminaires to achieve the best visual appearance.

Location should be selected with consideration of potential glare. Luminaires located high up, aiming down should not be used if a similar result can be achieved by using a luminaire mounted low down, lighting up. In either case care should be taken to ensure that light spill and glare are avoided.

Techniques for lighting landscape

All elements of the external landscape do not need to be directly illuminated. A balance between light and shadow should be created in each location. The aim should be to create a balanced overall composition and avoid over lighting or under lighting. Consideration should be given to the creation of views and vistas that reveal various perspectives for pedestrians and those traveling by car and boat.

Uplighting:

Uplighting is an effective and discreet method of lighting most trees. Utilizing flush recessed uplights or surface mounted spotlights within protective enclosures. The optimum location of the luminaire will depend on the size, habit and species of tree.

Moonlighting:

Luminaires can be installed in mature trees with a broad spread of branches. Light can be cast downwards to project broken patterns of light onto the ground below.

Silhouetting:

As an alternative to direct highlighting, trees can be silhouetted against walls or other illuminated parts of the landscape, such as water, to create additional depth and interest.

Festoon Lighting:

Strings of miniature filament lamps can also be installed in trees to create a festive sparkling effect.

Fountains and Water Features

The lighting design for water features and fountains is a specialist activity often undertaken by the manufacturer or supplier of the water feature, since they will have the greatest practical experience of the lighting effects that work best with the type of water display.

There are a number of issues to consider when designing the feature lighting of water displays.

All equipment must be watertight and fully submersible. A possible exception is fiber optic lighting, which separate the light source and electricity from the lensed fiber optic harness that delivers the light at the required location within the water.

The location of the luminaires in relation to water jets and cascades is critical. Light from underwater luminaires will be refracted or reflected depending and the angle of incidence of the light beam. Bubbles and particles in the water will also tend to disperse the light.

The surface finishes within the water feature will also affect the lighting. A elements of a water feature or cascade should be designed to work in harmony with each other. Ideally the installed lighting should be a “loose fit” that can set up and final locations agreed during the final commissioning when the water feature is operational.

Signage and Electronic Advertising

Any signage and interpretative systems using lighting in the Three Rivers Park should be treated with great sensitivity to avoid overpowering the lighting required for pedestrian safety, scenic experience and way finding.

A regulatory framework needs to be developed for controlling the visual impact of the electronic media. Such a framework needs to assess the environmental and aesthetic aspects, but needs to also consider how the management and content programming should reflect the broader public realm objectives.

Art Installations

The installation of new artworks offers a cost effective opportunity to fully integrate lighting into a stand-alone project, on both large and small scales. Costs may be rationalized as the artwork and lighting scheme are fully integrated from conception.

Scheme selection

There will always be more potential lighting schemes in Three Rivers Park than there is the money available to fund them. It is therefore important to have a system of establishing priorities, which is flexible enough to continue for many years and to respond to changes in ideas and building development over those years.

The Riverlife Lighting Committee should be responsible for deciding scheme priorities, since they will have a broad overview of other strategic initiatives in Pittsburgh and will be able to influence local decision makers and stakeholders.

The following criteria should be considered in assessing scheme priority:

- The location of the scheme according to the key routes and key places identified in the strategy.
- The relationship of the proposed scheme to other Riverlife Task Force commitments
- The visibility of the proposed scheme from a major viewpoint
- The prominence of the building or area locally
- The architectural importance of the structure or site.
- The historic or civic importance of the structure or site.

Appointing a lighting designer

The appointment of a qualified lighting designer can be organized in many different ways. The lighting designer can be appointed by direct invitation, as part of multi disciplinary team or as a result of a limited or open competition.

Many lighting manufacturers will offer a free lighting design service, based on the use of their own products. A professional designer who is able to specify the appropriate luminaires for each application, free of commercial constraints should produce a better end result for the client.

The appointment procedure needs to reflect the scale and aspirations of the individual project. Clearly whilst the competition procedure is more demanding organizationally then a direct appointment in the case of key projects it produces much higher levels of design excellence.

- In the case of key lighting projects in Three Rivers Park
- bridge lighting
- primary public realm spaces lighting
- design of the universal lighting column
- a competitive selection process organized as International or National competitions is appropriate.

The adoption of the competition process for these key projects will ensure that Three Rivers Park benefits from the input of the best and most experienced lighting designers from a wide geographic pool of talent and experience.

Installation, Operation & Maintenance

A recognised electrical contractor employed by the property owner, with professional supervision by designers and/or engineers will generally carry out the installation of a lighting scheme.

The building owner will normally be responsible for the cost of the electricity supply to the lighting installation unless otherwise agreed. These costs can vary enormously according to the type of tariff used.

Lighting schemes are often on charged the ‘general block’ tariff instead of using ‘maximum demand’ or ‘evening and weekend’ tariffs, resulting in unnecessarily high lighting costs.

Street lighting is charged on the ‘public lighting’ tariff. This is usually available to anyone providing that the criterion of providing statutory or public safety lighting is met. For a building on it’s own this is not usually the cheapest lighting tariff. The building owner should therefore be encouraged to seek the help of the local energy supplier in making a final decision.

Running costs can be contained if the lighting installation is correctly controlled. It is recommended that building facade lighting should be switched on by photocell control, perhaps 30 minutes after the streetlighting comes on. Facade lighting, unless it is primarily for building security should be switched off by time clock at midnight, or at a time suited to other night time activities in the surrounding area.

The cost of most urban exterior lighting projects represent a low level of capital expenditure for a very large return in terms of added value to property development, improved public realm spaces and increased safety.

The potential benefits to the community of good quality outdoor lighting are huge and these benefits can be provided at much less cost than is commonly thought.

Economy in the use of energy is essential. All future lighting schemes within Three Rivers Park should be designed to utilise light as efficiently as possible to avoid waste and minimise environmental impact. In the past, when energy was relatively cheap there was a tendency to achieve results by using large quantities of light, with luminaires which were inexpensive and tungsten lamps of low efficacy. In the 21st Century, a more rigorous and environmentally aware approach to the design and specification of lighting installations is required.

The total cost of any lighting installation will be the sum of the capital cost and the operating costs.

Capital costs will include:

- Professional design fees
- Electrical Installation
- Capital cost of lamps, luminaires control gear and accessories
- Lighting columns, towers and other fixing requirements
- Lighting control equipment, meters and housings
- Electrical connection

Operating Costs will include:

- Electricity
- Replacement lamps
- Routine maintenance, inspection, repairs and re-painting
- Supervisory, clerical, transport, plant and overhead charges
- Way-leaves, rentals, insurance
- Removal, storage and re-installation of equipment for temporary and seasonal projects.

It is convenient when comparing the economics of alternative lighting systems to assess all costs on an annual basis. As a rule of thumb, annual running costs for most exterior lighting installations, including electricity, cleaning and re-lamping are likely to be less than 10% of the initial capital cost of the equipment.

When considering the overall costs of a proposed lighting installation, capital costs can be expressed as yearly costs based on the expected life of the installation. For exterior lighting, a life cycle of at least 20 years should be considered. Most operational costs will be incurred annually. Where components such as discharge lamps are only replaced every two or three years, the appropriate proportion of their replacement cost can be allocated to the charges for the year. A simple comparison between the annual costs of alternative lighting systems can be obtained by adding the annual amortisation of equipment costs to the annual operating cost (more refined costing methods might be required for larger projects).

In comparing alternative lamp/luminaire combinations for exterior floodlighting, it is useful to evaluate as the common base the total annual cost per thousand beam lumens, rather than repeatedly working out complete designs to satisfy illuminance and uniformity requirements.

There are considerable differences in the periods of time during which different types of exterior lighting installations will be in use (See Table 4.1). Anticipated operating hours should be taken into account when considering total life cycle costs.

With regard to energy costs, several types of electricity tariff will be available and local electricity suppliers should be consulted at an early stage in the project for the most competitive price or tariff.

If an installation is only likely to be running for a short period of time per annum, it may cost less to hire equipment from a specialist contractor or manufacturer than to purchase and permanently install luminaires.

Table 4.1 Annual operating hours for exterior lighting installations

| Type of Installation | Number of days use per annum | Average hours of use per day | Total hours of use per annum |
|-------------------------|------------------------------|------------------------------|------------------------------|
| Street Lighting | | | |
| Dusk till Dawn | 365 | 11 | 4,000 |
| Dusk till Midnight | 365 | 6 | 2,200 |
| Floodlighting | | | |
| Security Lighting | 365 | 11 | 4,000 |
| Decorative Lighting: | | | |
| All year, all night | 365 | 11 | 4,000 |
| All year, part night | 365 | 11 | 2,200 |
| Summer Only, Part Night | 200 | 6 | 1,200 |

Project budget evaluation

There are a number of other factors to consider when evaluating the cost of a lighting project:

- The installation of a lighting scheme may have an impact on existing infrastructure, which may need to be repaired or replaced after new ducts, or containment routes have been installed.
- Co-ordination with the installation of other services (utilities, telecommunications etc.) may reduce installation costs and improve the appearance of the built environment.
- Re-utilizing existing wiring points may reduce initial installation costs, but may compromise design intent.
- Since the scale of many of the projects proposed for Three Rivers Park is ambitious, costs associated with the construction process will have to be considered. These may include closure of vehicular routes and the diversion of traffic.
- Costs should be considered on a project-by-project basis, as each installation will place different demands on its location.
- The execution of many projects simultaneously, or to a phased program, may also prove more cost-effective than each scheme being treated as an individual project. For example, construction start-up overheads and preliminaries will be consolidated.
- Rationalisation of proposed luminaires and lighting equipment will also result in increased discounts from lighting manufacturers for bulk orders.

| Table 4.2 Indicative Budget Costs | Estimated Cost Per Installed Luminaire US Dollars (\$) | Total Estimated Cost of Lighting Equipment US Dollars (\$) |
|--------------------------------------|---|---|
| Bridges: | | |
| Smithfield Street Bridge | N/A | \$325,750.00 |
| | | Straight Cold Cathode |
| Smithfield Street Bridge | N/A | \$486,250.00 |
| | | Curved Cold Cathode |
| Monongahela Bridge | N/A | \$300,000.00 |
| West End Bridge | N/A | \$480,000.00 |
| Fort Duquesne Bridge | N/A | \$405,000.00 |
| Veteran's Bridge | N/A | \$325,000.00 |
| Fort Pitt Bridge | N/A | \$420,000.00 |
| Liberty Bridge | N/A | \$760,000.00 |
| Panhandle Bridge | N/A | \$400,000.00 |
| South 10 th Street Bridge | N/A | \$400,000.00 |
| Fort Wayne Bridge | N/A | \$300,000.00 |

Budget indicators

Many factors will influence the final cost of each individual project within Three Rivers Park. Much will depend on the nature and complexity of the design itself, and its integration with surrounding landscape, architecture, art, street furniture, and other structures. Cost certainty can only be achieved by carrying out a full detailed design (which is not within the scope of the lighting strategy).

Table 4.2 table shows indicative equipment costs for the various types of lighting proposed for bridges, trails, boardwalks and roads. These budget costs are provided in order to illustrate the potential costs of key elements of the strategy. They should be used for guidance only at this stage.

During the concept, scheme and detail design process, the costs of each project should be monitored in relation to the original budget estimate.

| Table 4.2 Indicative Budget Costs Contd.. | Estimated Cost Per Installed Luminaire US Dollars (\$) | Total Estimated Cost of Lighting Equipment US Dollars (\$) |
|---|---|---|
| Trails: | | |
| Pole Top luminaires for trails, utilizing CDM ceramic metal halide lamp | \$3,500.00 to \$4,000.00 (per luminaire) | N/A |
| Flush recessed in-grade uplighter to highlight trees, Utilising CDM ceramic metal halide lamp. | \$2,800.00 to \$3,000.00 (per luminaire) | N/A |
| Wall mounted downlighters utilising CDM ceramic metal halide lamp. | \$750.00 to \$800.00 (per luminaire) | N/A |
| Twin lamp full cut-off lantern utilising CDM ceramic metal halide lamp, for roads and highways. | \$3,500.00 to \$3,800.00 (per luminaire) | N/A |
| Lighting integrated into the design of benches and street furniture. | \$1,000.00 to \$3,000.00 9Per furniture item dependent on design.) | N/A |

In order to realise lighting design objectives, it is suggested that funding for individual projects should be split into clearly defined components. For example:

a. Baseline

Lighting of vehicular routes and pedestrian areas, to secure the health and safety of all users of the public realm (this would include all roads, pedestrian trails and boulevards).

Operating hours 365 days a year, dusk till dawn.

b. Enhanced Baseline

Lighting of squares and open areas where vehicle access after dark is restricted or excluded (apart from emergency services (i.e. Point State Park).

Operating hours 365 days a year, dusk till dawn.

| Table 4.2 Indicative Budget Costs Contd.. | Estimated Cost Per Installed Luminaire US Dollars (\$) | Total Estimated Cost of Lighting Equipment US Dollars (\$) |
|---|---|---|
| Trails: | | |
| Pole Top luminaires for trails, utilizing CDM ceramic metal halide lamp | \$3,500.00 to \$4,000.00 (per luminaire) | N/A |
| Flush recessed in-grade uplighter to highlight trees, Utilising CDM ceramic metal halide lamp. | \$2,800.00 to \$3,000.00 (per luminaire) | N/A |
| Wall mounted downlighters utilising CDM ceramic metal halide lamp. | \$750.00 to \$800.00 (per luminaire) | N/A |
| Twin lamp full cut-off lantern utilising CDM ceramic metal halide lamp, for roads and highways. | \$3,500.00 to \$3,800.00 (per luminaire) | N/A |
| Lighting integrated into the design of benches and street furniture. | \$1,000.00 to \$3,000.00 9Per furniture item dependent on design.) | N/A |

c. Feature Lighting

Specific feature lighting of buildings, structures, soft & hard landscape and artwork. This category comprises all decorative lighting elements apart from lighting required for health and safety reasons.

Minimum operating hours would be key days of the week, holidays and months of the year when night time use of the public realm is expected. For example, Thursday, Friday, Saturday and Sunday from dusk until 3am.

d. Temporary Lighting

This would include funding for the lighting of special events or seasonal festivals. Christmas lighting, “son et lumiere” events and temporary art installations would come into this category.

This approach will enable implementation of individual elements of the scheme as funds allow, without losing sight of the overall objectives of the lighting strategy.

In instances where lighting budgets are seriously constrained, a number of cost reduction strategies can be employed. These might include reducing overall surface brightness and using lower wattage luminaires; or designing variable lighting schemes where different amounts of the lighting are used at different times of the week month or year, (which can also reduce overall running costs without compromising design intent). Selective highlighting of a building or feature rather than overall floodlighting may save energy and reduce overall lighting equipment costs. Using solar time clocks to ensure that lighting is only activated after dark will also reduce maintenance and energy costs.

Fundraising

The commercial benefits associated with creating a dynamic external environment at night are an intrinsic part of urban regeneration and renewal. Areas that project a thriving and progressive image will instil confidence within prospective clients and investors.

There are many ways in which the design, installation and operation of exterior lighting can be funded:

Federal & Local Government Funding:

Lighting within the public realm, such as streets highways and public buildings and monuments are usually funded directly by government In Pittsburgh, the Department of Engineering and Construction is responsible for lighting in the public realm.

Regeneration Funds & Grants

In Europe, regeneration funds and grants are often available to fund innovative projects

In the UK Regional Development Agencies (RDA's) were set up by Government to promote sustainable economic development in England. They are business led. Their main tasks are to help the English regions improve their relative economic performance and reduce social and economic disparities within and between regions. These agencies are financed from central government. The agencies can spend their funds as they see fit, to achieve the regional priorities identified in their corporate plans.

For example, in 2002 Weston-super-Mare, a town in the South West of England commissioned a lighting strategy for its town centre and sea front promenade. The strategy document enabled the local council to secure £16,000,000.00 (\$30,000,000.00 US dollars) of funding from the Regional Development Agency for lighting related projects.

Local Business & Enterprise Funding

Local Building owners can be encouraged to invest in exterior lighting as an outward expression of civic pride. A recent façade lighting project in Penn Avenue is an example of local philanthropy in action.

Commercial Sponsorship

Sponsorship of lighting is a relatively new idea that could be used as a significant part of the funding for Three Rivers Park lighting strategy.

Commercial sponsorship is a fast growing industry. Regularly used in the field of sport and the arts, the application of sponsorship has broadened to include conservation, charity broadcasting and many other activities.

Many cities welcome sponsorship activities for a wide range of sporting and cultural events and may have a sponsorship advisor. The Mayor of London for example, has a sponsorship office that actively seeks sponsorship for a wide range of cultural events, functions and activities.

Notable lighting installations, such as Pittsburgh's many bridges may offer substantial potential benefits to sponsors.

Sponsorship is not just a charitable donation to a worthy cause. Potential sponsors will look for evidence of a proper return on the investment in terms of PR benefit and an effective support for their trading activities and business development. Some years ago, the permanent exterior lighting of the Italianate central courtyard of the Victoria & Albert Museum in London was sponsored by the Pirelli. The key to successful sponsorship deals is finding a synergy between the project and the potential sponsor.

The announcement of sponsorship will provide some PR benefit to the sponsoring organisation, particularly if the lighting installation is high profile, visually attractive and of benefit to the community. Imaginative use of sponsorship can provide very significant support for the sponsoring organisation's marketing, promotional and corporate entertainment activities.

Sponsorship may comprise one initial payment to cover the capital cost of the project or in some cases, sponsorship may relate to the operation of the installation over agreed periods. Equally, sponsorship may be on a “sole sponsor” or multiple sponsor bases. It is normal to have a clear sponsorship agreement to define the terms and conditions applicable to the project.

| LOCATIONS | YEAR 1 | YEAR 2 | YEAR 3 | YEAR 4 | YEAR 5 |
|---|--------|--------|--------|--------|--------|
| BRIDGES | | | | | |
| POINT STATE PARK MON WHARF | | | | | |
| URBAN RIM WEST END BRIDGE | | | | | |
| OHIO LASER GATEWAY | | | | | |
| SOUTH SHORE PRIVATE SECTOR PROJECTS | | | | | |
| NORTH SHORE PRIVATE SECTOR PROJECTS | | | | | |
| MAKING CONNECTIONS PUBLIC AND COMMUNITY SECTOR PROJECTS | | | | | |
| PUBLIC ART LIGHTING PROJECTS TEMPORARY AND PERMANENT | | | | | |



Similar to Lyon, Three Rivers Park could be significantly transformed within a period of five to ten years. The above chart gives a broad indication of the possible prioritization of projects and is designed to show the need for clear milestone achievements. These achievements need to be of a sufficient scale so that they are able to produce lasting transformative effects as outlined in the lighting strategy.

Background

The Three Rivers Park Lighting Strategy was commissioned by the Riverlife Task Force, as part of a wider visioning exercise that will eventually create a grand public park in the heart of downtown Pittsburgh.

The study area is at the confluence of the Monongahela, Allegheny and Ohio Rivers in Pittsburgh.

Three Rivers Park will extend from West End Bridge on the Ohio River to the 16th Street Bridge on the Allegheny River and 10th Street Bridge on the Monongahela River.

Lighting has been identified a key element in the design of the park. The primary objective of this project is to provide a coherent and unifying Lighting Strategy that will improve the quality, consistency and efficiency of night lighting of the riverfront in downtown Pittsburgh.

The brief from the Riverlife Task Force defined the key objectives of the lighting strategy as follows:

- To develop a large-scale transformative lighting installation concept aimed at promoting Pittsburgh and its riverfront internationally.
- To provide guidelines for the lighting of river edges, trails, bridges and scenic boulevards.
- To establish lighting guidelines that define artificial lighting standards for the Park and consider issues such as sustainability, energy consumption and quality of design.
- To develop an implementation strategy that identifies the steps that need to be taken to implement the lighting strategy.

Existing Design Framework

The lighting strategy builds on input from stakeholders as a number of existing strategic initiatives. The following documents were referred to in the preparation of the lighting strategy:

- City of Pittsburgh Zoning Code
- Riverlife Task Force Vision Plan
- Riverlife Task Force “Connecting The Loop”
- The Three Rivers Park Design Handbook
- River Conservation Plan by Pennsylvania Environmental Council
- Pittsburgh Downtown Plan
- Pittsburgh Regional Parks Masterplan by Pittsburgh Parks Conservancy
- City of Pittsburgh Riverfront Development Plan

Existing Trail Conditions

In many areas of the riverfront the existing lighting in the public realm is in a poor physical condition. **(1)** There is no consistent and clear definition of the river edge. The existing lighting systems lack cohesion and there is an overall inconsistency of approach that adds to the visual cacophony in an already visually competitive environment.

Distinctive “saturn ring” pedestrian-scale lighting columns currently illuminate much of the river walk. The luminaires utilise “white light” metal halide lamps and appear to be unique to the river edge. The luminaires have prismatic spheres enclosing the lamps, which provide little optical control. **(2)**

On the North shore, there is a mix of lighting types. **(1. 2. 3. 4.)** The efficiency of the existing lighting is often diminished by low level of landscape and routine maintenance with many luminaires obscured by trees. **(5)** The special effect landscape and the public art lighting is frequently not working and does show a distinct lack of regular maintenance.

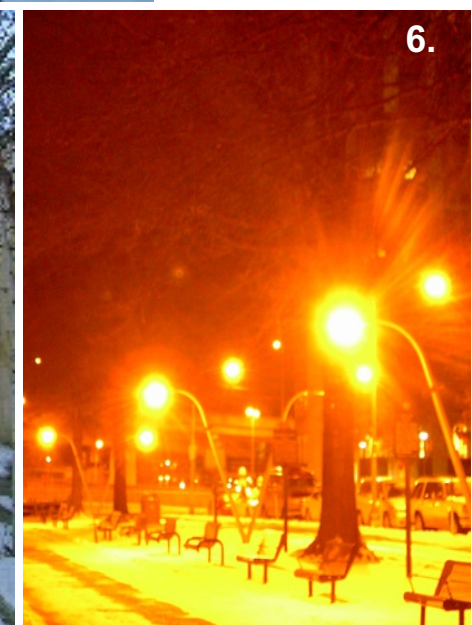
The underside of many bridges is insensitively lit by and fitted out with highway luminaires **(3)** only accentuating the claustrophobic feel of these spaces at nighttime.

In Point State Park the river edge is characterised by a hard-edged concrete quayside at low level, connected to an upper footpath by continuous concrete steps. Aged twin-headed lighting columns utilising high-pressure sodium lamps Luminaires **(6)** are located between trees on the upper footpath. Although the light columns provide some light for the lower river walk, there is no local illumination on the river edge itself. The fountain lighting is very obsolete both in design and performance.

Elevated highways create an unpleasant night time environment that does not encourage pedestrian use. In many instances, there is no direct pedestrian-scale lighting for beneath the ramps. At night and the area is dark and uninviting. Many luminaires have only partially shielded light sources and appear excessively bright at night.

The surface carparking lots adjoining the Three Rivers Park are uniformly overlit with no shielding on the luminaires on the river boundaries and as such are responsible for greatly reducing the nighttime vision of people in the park.

Overall the result is an unsatisfying night time environment that does not encourage visitors to explore the area after dark.



Methodology

Following an initial briefing meeting with the project co-ordination team in early January 2004, the Art2Architecture team carried out a detailed survey of the Three Rivers Park, by day and night.

Briefing Meetings were held with the Riverlife Partnership in Pittsburgh and a detailed survey of the study area was undertaken. Meetings were held with North Shore Orientation, the City Planning Department and the Riverlife Lighting Committee. The survey included a review of the existing lighting installations and an assessment of the night time activity in the Three Rivers Park The perceived atmosphere of the study area was also assessed.

The team considered topography, distant views, routes into and out of the area, landmarks and focal points.

A photographic survey of the study area, with reference to specific lighting issues was undertaken (See Appendix B.).

Monuments, buildings of architectural interest and the character of the different districts of downtown Pittsburgh were assessed .

Following this detailed information gathering exercise, the key themes of the lighting strategy were identified and an overall lighting design palette suggested to the Riverlife Partnership Lighting Committee.

Public charettes were undertaken in Pittsburgh during the development of the proposals to assess and respond to public comments on the lighting strategy.

During the design development stage a visit to Pittsburgh was arranged to meet with river users and other special interest groups. At this point, feedback was sought from all interested parties. These consultation meetings influenced the direction of the strategy in a positive way.

Meetings were held with these stakeholders and organizations:

City of Pittsburgh:

- Department of City Planning and Zoning
- Department of Public Works
- City Parks and Recreation
- Pittsburgh Parking Authority
- Sports and Exhibition Authority
- Urban Redevelopment Authority

County of Allegheny:

- Department of Planning
- Department of Public Works

Parks, Open space and Recreation:

- Pittsburgh Cultural Trust
- Pittsburgh History and Landmarks Foundation
- Preservation Pittsburgh
- Western Pennsylvania Conservancy

- Allegheny Land Trust

Property Owners:

- Alcoa corporation
- Buncher Company
- Forest City Enterprises
- Carnegie Science Centre
- Heinz Corporation
- Del Monte Corporation
- Pittsburgh Terminal Properties

River Users:

- River Rescue
- Army Corps of Engineers
- Waterways Association
- Port of Pittsburgh
- U.S. Coast Guard
- Three Rivers Rowing
- Wenture Outdoors
- Gateway Clipper Fleet

Development Corporations:

- Continental Real Estate
- Lincoln Properties
- Rubinoff Company
- Ferchel Development
- Southside Local Development Corporation
- Mount Washington CDC

Transportation and Infrastructure:

- Penn DOT
- Duquesne Light
- Port Authority
- Alcosan
- Pittsburgh Water and Sewer Authority

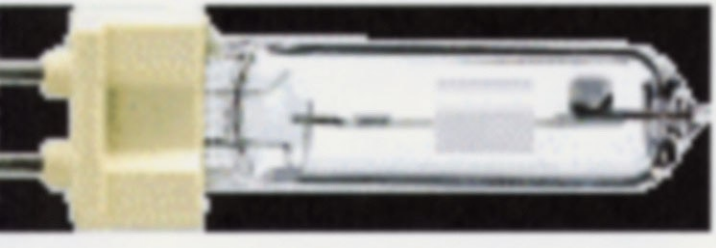
Neighbourhood groups:

- Downtown Partnership
- Downtown Living Initiative
- Hill district Community Development Corporation
- Hill Consensus Group
- Find the Rivers
- Neighbours in the Strip
- Northside Leadership Conference

Comments and suggestions received during the consultations were considered and our initial proposals adjusted accordingly. Following a further public presentation of the proposals the Three Rivers Park lighting strategy was finalised.

CERAMIC METAL HALIDE LAMP CHARACTERISTICS FLUORESCENT LAMP CHARACTERISTICS

- Average rated lamp Life 10,000hrs.



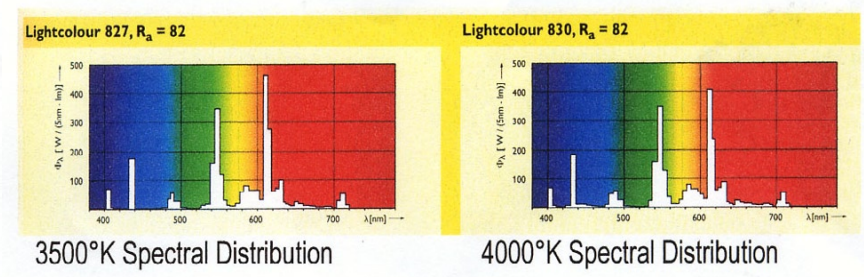
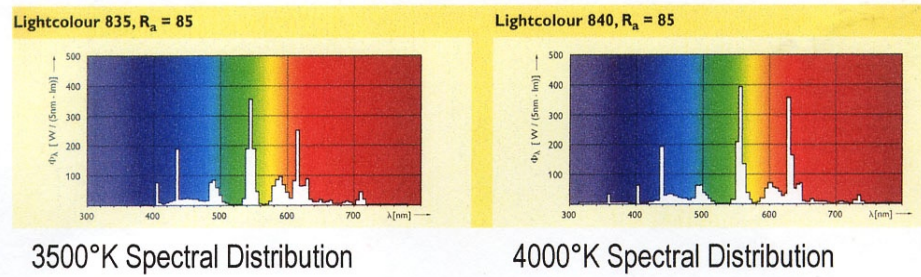
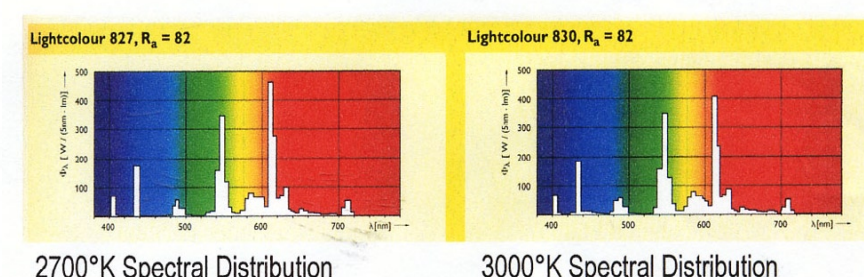
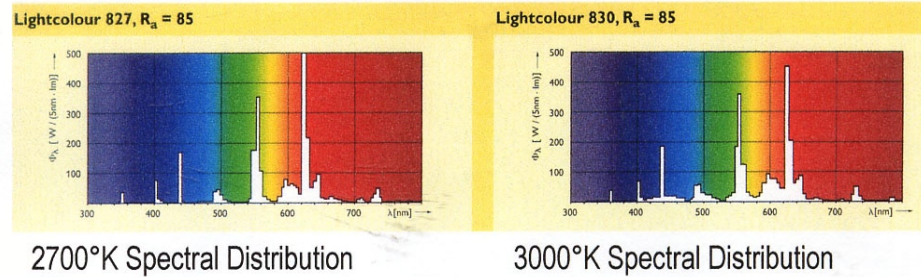
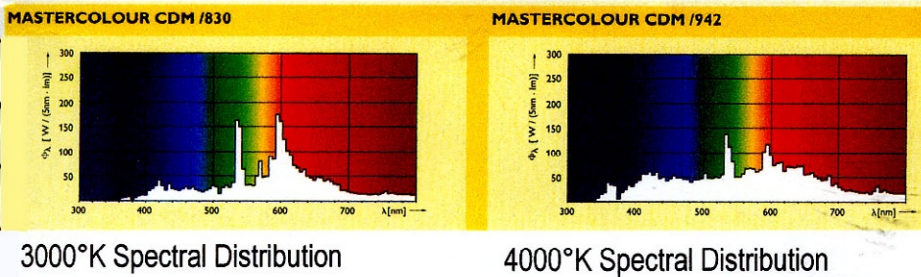
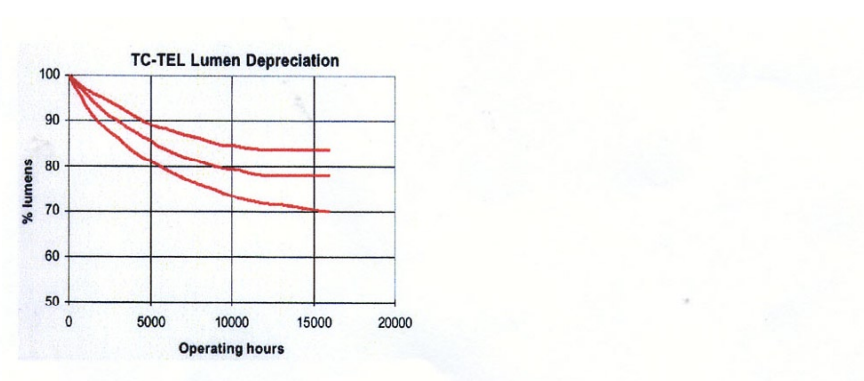
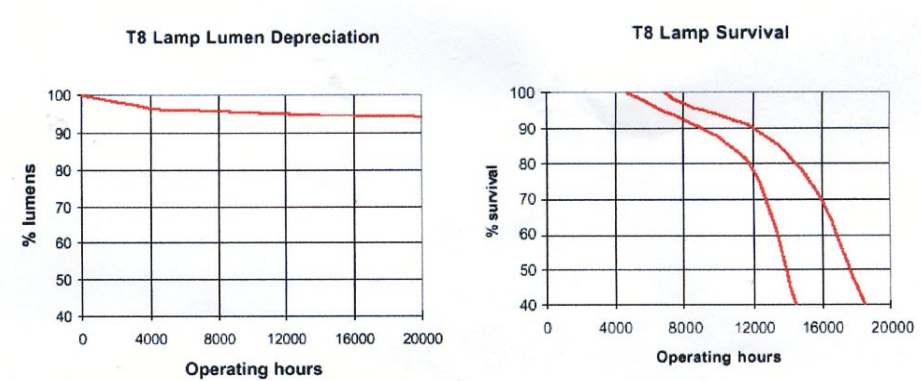
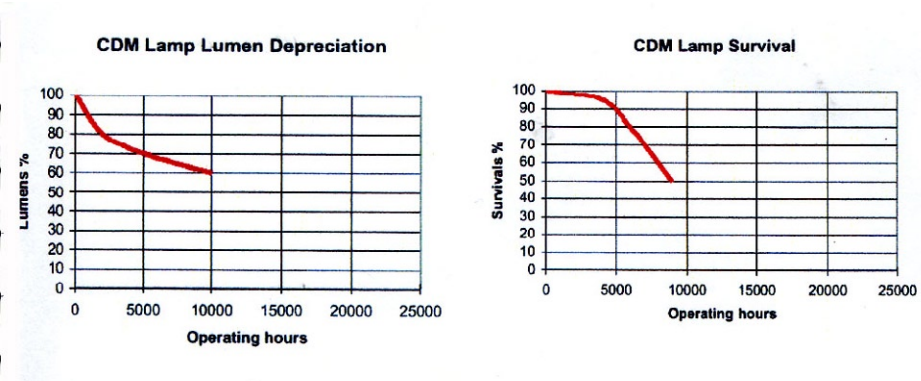
FLUORESCENT LAMP CHARACTERISTICS

- Average rated lamp Life 15,000hrs.



COMPACT FLUORESCENT LAMP CHARACTERISTICS

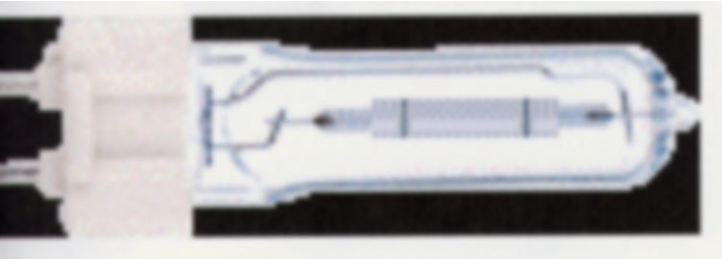
- Average rated lamp Life 10,000hrs.



HIGH PRESSURE SODIUM LAMP CHARACTERISTICS LED LAMP CHARACTERISTICS

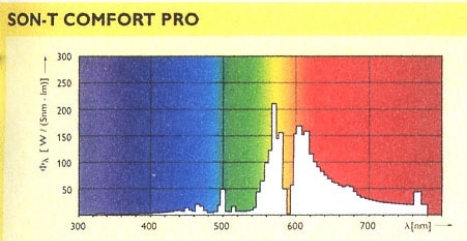
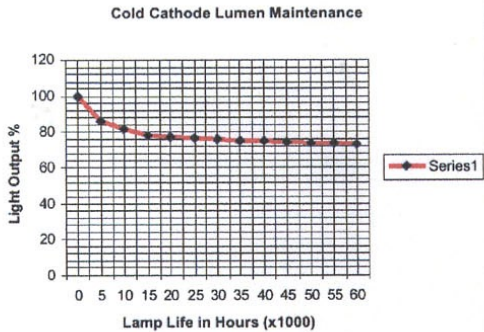
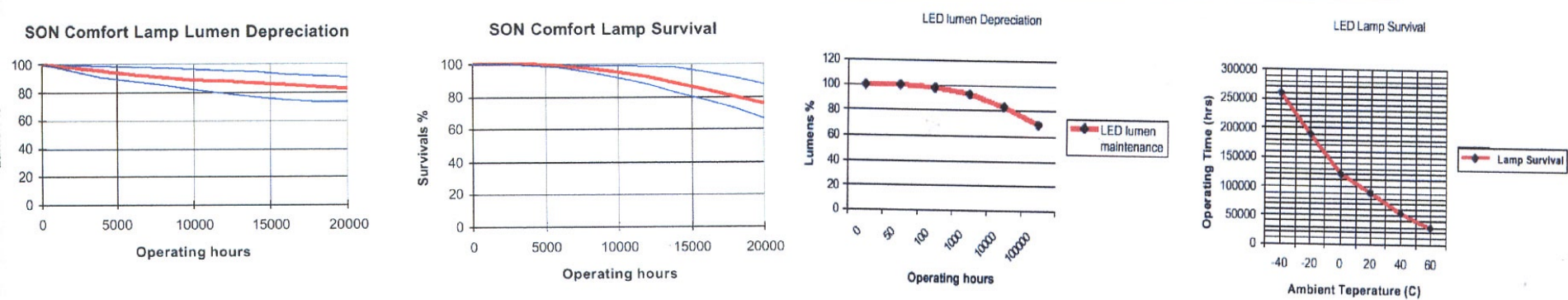
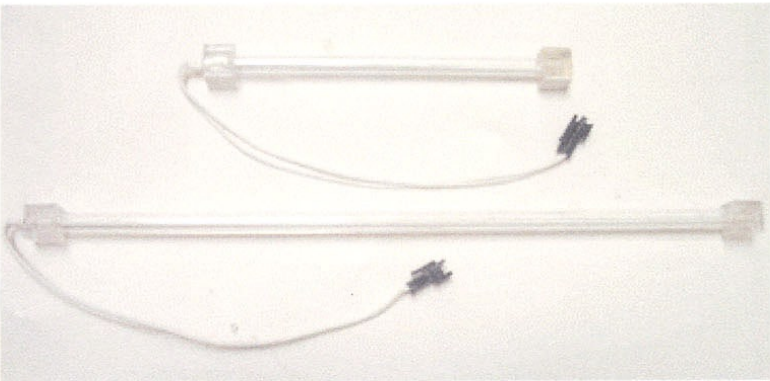
- Average rated lamp Life 20,000hrs.

- Average rated lamp Life 100,000hrs
(Differing life according to color)



COLD CATHODE LAMP CHARACTERISTICS

- Average rated lamp Life 50,000hrs
(Differing life according to color)



2200 & 3000°K Spectral Distribution



Cold Cathode Color Selector

Glossary of lighting terms

Quantities & Units of Light

Luminous Flux
The light emitted by a source, or received by a surface (expressed in lumens).

Lumen
SI unit of luminous flux describing the quantity of light emitted by a light source. One lumen is the luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform luminous intensity of one candela.

Luminous Intensity
The quantity which describes the power of a source or illuminated surface to emit light in a given direction. It is the luminous flux emitted in every narrow cone containing the given direction divided by the solid angle of the cone. The result is expressed in Candelas.

Candela
SI unit of luminous intensity. 1 candela = 1 lumen per steradian.

Candlepower
A now obsolete term denoting the luminous intensity, expressed in candelas.

Illumination
The process of lighting an object.

Illuminance
The luminous flux density at a surface, or the incident luminous flux per unit area. Expressed in Lux.

Service Illuminance
The mean illuminance throughout the life of an installation and averaged over the relevant area.

Standard Service Illuminance
The service illuminance recommended for standard conditions.

Lux
The SI Unit of illuminance, equal to 1 lumen per square metre.

Lumen per Square Foot (Footcandle)
A non-metric unit of illuminance, equal to 10.764 Lux. Known as the Foot Candle.

Luminance
A term which expresses the in agiven direction by unit area of a luminous or reflecting surface.

Candela per Square Metre
SI unit of luminance in lumens per square metre per steradian. Unit luminance in this system is that of a uniform plane diffuser emitting p lumens per square metre.

The Eye & Vision

Visual Field
The full extent of what can be seen when looking in a given direction.

Visual Capacity
The capacity for discriminating between details or objects which are very close together. The expression commonly used for an individuals acuity is the ratio of the standard distance at which the individual can read the line on a standard optician's chart to the (standard) distance at which a person with normal sight can just read the line (e.g. 6/12 means that the person can only read at 6 metres the line which a normally sighted person can read at 12 metres).

Adaptation
The process which takes place as the eye adjusts to the brightness or colour in the visual field.

Luminosity
A terms which expresses the visual sensation associated with the amount of light emitted from a given area. It is the subjective correlate of luminance. It is also known as "brightness"

Contrast
A term that is used subjectively and objectively. Subjectively, it describes the difference in appearance between two parts of the visual field seen simyltaneously or successively. The difference can be in brightness or colour. Objectively the term expresses the luminance difference ratio numerically I.e. contrast = (L2 - L1) divided by L1

Glare
The discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the general surroundings.

Disability Glare
Glare which impairs the ability to see detail without necessarily causing visual discomfort.

Discomfort Glare
Glare which causes visual discomfort without necessarily impairing the ability to see detail.

Direct Glare
Glare caused when excessively bright parts of the visual field are seen directly e.g. when lamps are inadequately shielded.

Colour

Correlated Colour Temperature
The temperature of a full radiator which emits radiation having a chromaticity nearest to that of the light source being considered e.g. the colour of a full radiator at 3,000K is the nearest match to that of a ceramic metal halide lamp.

Colour Rendering
A general expression for the colour appearance of objects when illuminated by light from a given source, compared with the appearance under light from a reference source. Good colour rendering implies similarity of appearance to that under an accepatable light source such as natural daylight.

Colour Appearance
Objectively measured as the chromaticity of a true white surface when illuminated by the light source. Subjectively, the hue of a white surface when illuminated by the source. Lamps of low correlated colour temperature are known as "warm". Lamps with a high correlated colour temperature are known as "cool".

Colour Rendering Index
A measure of the degree to which measured coours of surfaces illuminated by a light source conform to those of the same surfaces under a reference illuminant

Lamp Types

There are a variety of light sources suitable for exterior lighting:

Low pressure sodium (SOX)
High Efficacy
Long Lamp Life
Monochromatic yellow colour
Bad Colour Rendering
Long narrow clear tubular lamp

Only used for streetlighting where colour appearance is not important.

High Pressure Sodium (SON)
Medium/High Efficacy
Long Lamp Life
Warm Amber Colour (Some types almost white)
Poor Colour Rendering
Compact Lamps with clear or phosphor coated envelope.

Ubiquitous lamp used for streetlighting and exterior lighting. It can tend to distort surface colour and obscure the subtle differences between different types of stone. A useful light source if applied with care.

Metal Halide (MBI or HQI)
Medium Efficacy
Medium Lamp Life
White Colour (Some lamps are cool, some are warm)
Good colour rendering
Compact lamp with clear or phosphor coated envelope.

Less efficient than high pressure sodium but far superior in performance. A large range of wattages is available. There is a tendency for different lamps to exhibit marked differences in colour temperature due to minuscule variations in the mixture of halides within the arc tube.

Ceramic Metal Halide (CDM or HCI)
Medium Efficacy
Medium Lamp Life
White Colour Appearance (3,000K or 4,000K)
Good colour rendering
Compact lamp with clear envelope.

A colour constant metal halide lamp. Currently available in wattages up to 250W.

Mercury Discharge (MBF)
Medium efficacy
Medium lamp life
White Colour (mostly cool, but with some warm versions)
Acceptable colour rendering
Compact lamp with phosphor coating

Used in streetlighting, particularly in Europe and America.

Light-emitting Diode (LED)
Low efficacy
Long Lamp Life
Saturated Colours, Red, Blue Green, Amber, plus White
Poor colour rendering
Low energy, miniature light source

A distinctive low energy light source used for decorative and colour mixing applications.

Fluorescent
Medium efficacy
Medium Lamp Life
Full range of colours
Full range of colour rendering
Long tubular phosphor coated lamp.

Cold Cathode
Medium efficacy
Long Lamp Life

Full range of colours
Full range of colour rendering
Long tubular phosphor coated or clear lamp.

Tungsten Halogen
Low efficacy
Low Lamp Life
Warm white colour (3,000K)
Excellent colour rendering
Small tubular lamp or compact low voltage lamp.

Tungsten
Low efficacy
Low Lamp Life
Warm white colour (2,700K)
Excellent colour rendering
Small 'bulb'
A domestic light source, not suitable for exterior lighting, except within small scale decorative luminaires.

Reference Documents:

Illuminating Engineering Society of North America
 IESNA Lighting Handbook, 9th Edition December 2000
 Ref: IESNA HB-9-2000
 Illuminating Engineering Society of North America
 Recommended Practice Guide “Lighting For Exterior
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 Ref: IESNA RP-33-99
 Illuminating Engineering Society of North America
 IESNA TM10 Technical Memorandum January 2000
 Addressing Obtrusive Light (Urban Sky Glow and Light Trespass)
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 Outdoor Lighting Installations
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 Home Office Research, Development and Statistics Directorate
 RDS, 2002
 Night Blight
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 Lighten our Darkness
 Lighting our Cities – Successes, Failures and Opportunities Royal
 Fine Art Commission, 1994
 Code for Lighting
 CIBSE, 2002
 §The Industrial Environment
 CIBSE, 2002
 §The Visual Environment
 CIBSE, 1996 (addendum 2002
 Lighting for Communal Residential Buildings
 CIBSE, 1997
 Commissioning Code L
 CIBSE, 2003
 Recommendations for the lighting of roads for motor and
 pedestrian traffic.
 CIE136-2000
 Guide for lighting exterior work areas.
 CIE129-1998

Urban Lighting
 CIE136-2000
 Road Lighting and the Environment
 Department of Transport 1993

Professional Bodies in the USA

The Illuminating Engineering Society of North America
 (IESNA) – www.iesna.org
 International Association of Lighting Designers - www.iald.org