# HALE PARKWAY

ECONOMIC ASSESSMENT

EARTH ECONOMICS

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EARTH ECONOMICS

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# EXECUTIVE **SUMMARY**

Hale Parkway, located within the Upper Montclair Basin in Denver, Colorado, has been identified as a promising project site for the installation and demonstration of a natural open drainage channel that can generate significant community benefits, including recreational and aesthetic benefits, property value uplift, improved air quality, urban habitat, and cooling benefits during Denver's hot summers. The Montclair Basin Outfall System Plan team has pursued extensive community engagement to gain resident input into the design of a future neighborhood facility along Hale Parkway that would double as a stormwater drainage channel, as well as a public parkway with a multi-use trail.

This report provides an overview of the community benefits and ecosystem services associated with the proposed Hale Parkway improvements, and estimates the additional economic value to be provided by the proposed project, based on established Benefit Transfer Method (BTM) methodologies. The report offers an overview of the range of community benefits commonly associated with green stormwater infrastructure sites, such as the proposed multi-purpose community asset for Hale Parkway. These benefits include: regulating services, such as air quality purification, carbon storage and sequestration, and urban heat island effect mitigation; supporting services, such as habitat provision; and additional community benefits, such as improved property values, recreational and educational opportunities, improved physical and mental health, and strengthened community bonds.

To assess project impacts, ecosystem services have been estimated for the existing Hale Parkway road (baseline scenario), as well as the proposed Hale Parkway concept design, focusing on the marginal benefits accruing from the concept design improvements. The value of ecosystem services has been estimated using the Benefit Transfer Method (BTM), drawing on peer-reviewed valuation studies of similar locales and conditions, which have been "transferred" to the study site, much like the process for property appraisals. For some ecosystem services, a land cover approach was used to estimate annual contribution (in dollars per acre) of areas covered in grasses, trees, or shrubs. Other ecosystem services which are more influenced by social and spatial contexts were analyzed at the overall project scale. Conservative estimates were used throughout the analysis to avoid overestimating project benefits.

Table 1 summarizes the total economic benefits associated with the baseline (Hale Parkway as it currently exists) and the post-installation scenario (the full Hale Parkway concept design), as well as the marginal benefits associated with the Hale Parkway improvements. The $1.1 million to $3.4 million in additional annual benefits (average value of $2.2 million), expressed as Net Present Value over a 50-year period, amounts to $53.7 million to $170.4 million (average value of $112.0 million) without discounting, or $29.0 million to $92.0 million (average value of $60.5 million) using a 2.75% discount rate.

This analysis demonstrates the significant additional value generated by the proposed Hale Parkway improvements, above and beyond the existing value of the current Hale Parkway area. A green stormwater infrastructure project that doubles as a community asset greatly enhances community resilience and wellbeing, and provides a substantial return on investment to the local community.

**TABLE 1** ANNUAL BENEFITS BY SCENARIO (2017$)

| | **BASELINE SCENARIO** *VALUE PER YEAR* | | | **POST-INSTALLATION** *VALUE PER YEAR* | | | **MARGINAL GAIN** *VALUE PER YEAR* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low | Average | High | Low | Average | High | Low | Average | High |
| Total | $20,250,852 | $52,763,448 | $85,276,043 | $21,324,259 | $55,003,704 | $88,683,150 | $1,073,407 | $2,240,256 | $3,407,106 |

# INTRODUCTION

Hale Parkway, located within the Upper Montclair Basin in Denver, Colorado, has been identified as a promising project site for the installation and demonstration of a natural open drainage channel that can generate significant community benefits, including recreational and aesthetic benefits, property value uplift, improved air quality, urban habitat, and cooling benefits during Denver's hot summers. The Montclair Basin Outfall System Plan team has pursued extensive community engagement to gain resident input into the design of a future neighborhood facility along Hale Parkway that would double as a stormwater drainage channel, as well as a public parkway with a multi-use trail.

This report provides an overview of the community benefits and ecosystem services associated with the proposed Hale Parkway improvements, and estimates the additional economic value to be provided by the proposed project, based on established Benefit Transfer Method (BTM) methodologies. The report offers an overview of the range of community benefits commonly associated with green stormwater infrastructure sites, such as the proposed multi-purpose community asset for Hale Parkway. These benefits include: regulating services, such as air quality purification, carbon storage and sequestration, and urban heat island effect mitigation; supporting services, such as habitat provision; and additional community benefits, such as improved property values, recreational and educational opportunities, improved physical and mental health, and strengthened community bonds.

To assess project impacts, ecosystem services have been estimated for the existing Hale Parkway road (baseline scenario), as well as the proposed Hale Parkway concept design, focusing on the marginal benefits accruing from the concept design

# **OVERVIEW** GREEN INFRASTRUCTURE, ECOSYSTEM SERVICES, AND VALUATION

## GREEN INFRASTRUCTURE AS MULTI-FUNCTIONAL COMMUNITY ASSETS

Green infrastructure describes both healthy, natural systems like watersheds, forests, and natural shorelines, as well as engineered "infrastructure," such as green roofs, stormwater catchments, and urban forests. Much like how traditional built infrastructure (e.g., stormwater and sewer pipe networks) provides public benefits, green infrastructure assets – such as the proposed natural drainage channel for the Hale Parkway improvement plan – also provide stormwater drainage and water quality improvements. Some co-benefits may be obvious, such as offering new recreational opportunities, or expanding community gathering spaces. They may also be more subtle, like improving soil stability or providing pollinator habitat. As a whole, these co-benefits enhance community resilience and wellbeing, and increase the return on investment to the local community. The ability to replace traditional infrastructure while providing additional community co-benefits is what often sets green infrastructure projects apart.

In addition to **conveying stormwater runoff, mitigating flood risk, and improving surface water quality**, a multi-functional green stormwater infrastructure project (like the Hale Parkway improvements) can generate a range of co-benefits, some of which can be valued in monetary terms. These benefits include:

- **AIR QUALITY**
  Green infrastructure (GI) vegetation absorbs pollutants generated by car traffic and other urban activities, improving air quality and reducing the risk of lung disease.[1]

- **AESTHETIC BENEFITS AND PROPERTY VALUES**
  Homes that are adjacent to attractive views provided by GI have higher market value as compared to homes located further away from GI or without attractive views.[2]

- **MENTAL HEALTH**
  Access to and enjoyment in GI parks improve mental health and wellbeing, including improved mood and lowered levels of anxiety, depression, and stress.[3]

- **EDUCATION**
  GI parks provide opportunities for the public and can serve as a destination for school field trips and improve connection to and understanding of the environment.[4]

- **HABITAT**
  GI projects that includes tree canopy and native plant species can provide valuable habitat, especially for birds and pollinators.[5]

- **CARBON SEQUESTRATION**
  GI vegetation sequesters carbon dioxide, which is a greenhouse gas and one of the primary contributors to climate change.[6]

- **TEMPERATURE REGULATION**
  GI vegetation has been shown to cool down surface temperatures within cities and mitigate the need for air conditioning use during hot summer days.[7]

- **RECREATION AND PHYSICAL HEALTH**
  GI projects that include recreational amenities provide opportunities for recreational and physical exercise to communities. Higher exercise rates lead to reduced health care costs.[8]

- **COMMUNITY COHESION AND WELLBEING**
  GI projects that double as a community gathering space can improve social wellbeing through fostering social interactions, generating a shared sense of community and social support, and mitigating social isolation.[9, 10, 11, 12]

## NATURAL CAPITAL AND ECOSYSTEM SERVICES

The benefits communities derive from green infrastructure are also known as *ecosystem services*. Broadly speaking, ecosystem services describe the benefits people receive from natural capital. Natural capital refers to resources like plants, animals, soils, minerals, and energy resources. Like other forms of capital, natural capital provides a flow of goods and services. These goods and services are the basis of all other economic activity as they provide clean water, breathable air, nourishing food, flood risk reduction, waste treatment, climate stability, and other critical services. For example, during storm events, natural capital like grasses and trees capture and store excess stormwater runoff, reducing flood risk to human life and property. Green infrastructure, both natural and engineered, is a critical form of urban natural capital which provides many ecosystem service benefits to communities.

Ecosystem services are often grouped into four categories:

- **PROVISIONING SERVICES**
  Provide the physical materials which society uses. Community gardens grow food. Rivers provide drinking water as well as fish for food.
- **REGULATING SERVICES**
  Benefits obtained from the natural control of ecosystem processes. Intact ecosystems provide regulation of climate, water quality and delivery, and soil erosion prevention. They also keep disease organisms in check.
- **SUPPORTING SERVICES**
  Provide the habitats which support food webs and all life on the planet.
- **INFORMATION SERVICES**
  Allow humans to interact meaningfully with nature. These services include providing spiritually significant species and natural areas, natural places for recreation, and opportunities for scientific research and education.

## ECONOMIC VALUE OF NATURAL CAPITAL

The economic contribution of natural capital is critical to human wellbeing, but decisions affecting the environment haven't always considered those benefits. The language of budgets, costs, and return on investment is just beginning to incorporate these benefits into decision making, but the effect has been significant. Because ecosystems are living systems, natural assets are often more resilient and less costly to maintain than built infrastructure. Without these systems, many of the benefits we receive for free would need to be replaced by built infrastructure, at greater cost for construction and ongoing maintenance, as well eventual replacement. Acknowledging the economic value of natural capital demonstrates the cost-effectiveness of nature-based solutions, while raising awareness of the long-term connections between people and these natural assets.

## PRIMARY VALUATION METHODS

In the same way that economists can determine the value of real estate as a private asset, economists can also determine the contribution of ecosystem goods and services as public assets. For instance, although timber is bought and sold in markets, those prices usually ignore the contribution that trees provide to nearby communities, such as water filtration, wildlife and pollinator habitat, or flood risk reduction. Such economic contributions are known as non-market benefits. Because the full benefits of a given resource are not always included in market prices, economic value must sometimes be assessed indirectly, using a range of valuation techniques. These include:

- **REPLACEMENT COST**
  The cost to replace services provided by functioning ecosystems with man-made infrastructure *(e.g. levees and dams to replace natural floodplain protection)*.
- **AVOIDED COST**
  The losses which would be incurred if a natural ecosystem were removed or its function were significantly impaired *(e.g. flood extent reduced by wetlands and riparian buffers)*.
- **PRODUCTION APPROACHES**
  Ecosystem services which enhance market outputs *(e.g. moderate, regular rainfall can increase crop productivity).*
- **TRAVEL COST**
  Where benefiting from natural ecosystems requires travel, the willingness to incur such costs implies the level at which those services are valued *(e.g., recreation and tourism)*.
- **HEDONIC PRICING**
  Property values vary by proximity to certain ecosystem services *(e.g. homes with water views often sell for higher prices than similar homes without such views*).
- **CONTINGENT VALUATION**
  Estimates derived from surveys of the values assigned to certain ecosystem services *(e.g., willingness-to-pay to protect water quality)*.

The valuation of most ecosystem services is well-understood and straightforward. However, for ecosystem services that are difficult to quantify or value, benefits are often better described qualitatively.

## BENEFIT TRANSFER METHODOLOGY

To value ecosystem goods and services, Earth Economics employs the benefit transfer method (BTM), in which estimates of economic value are based on primary valuation studies of similar goods or services produced in comparable conditions *(e.g., climate, terrain, soils, species)*. BTM is often the only practical, cost-effective option for producing reasonable estimates of the wide range of services provided by ecosystems.

The application of BTM begins by identifying critical attributes of a landscape that determine ecological productivity and expected benefits. Primary valuations of similar ecosystems, geographies, and communities are then identified and assessed for their comparability with land cover types within the Hale Parkway study area. Estimates from primary studies are then standardized *(i.e., adjusted to common units, correcting for any inflation between the period of research and the present)* to ensure "apples-to-apples" comparisons. In this sense, BTM is similar to a property appraisal, in which the features and pricing of similar properties nearby are used to estimate value prior to a sale. While each process has its limitations, they are rapid and efficient approaches to generating reasonable values for making investment and policy decisions.

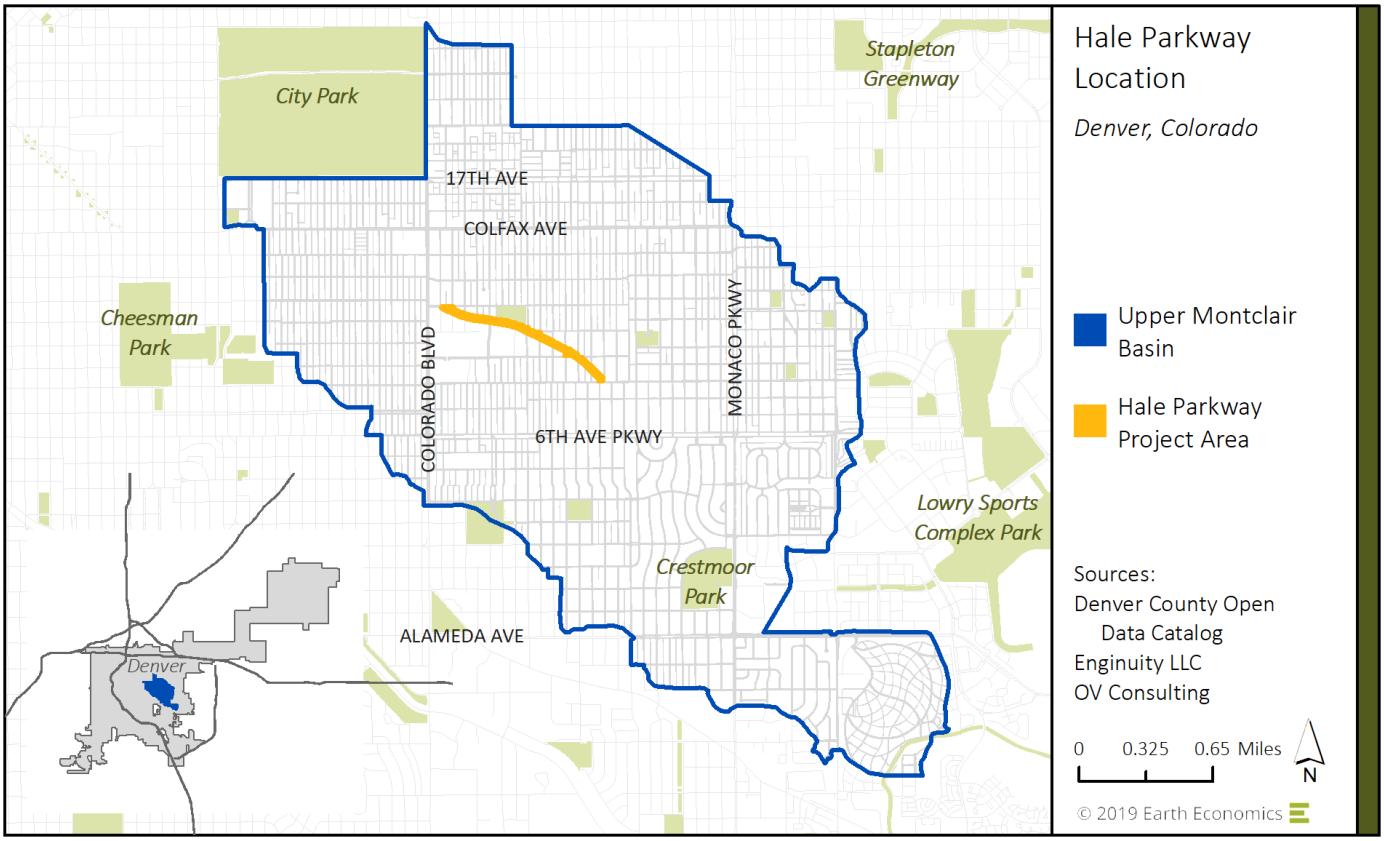
Interest in certain ecosystem services and land cover types has generated a substantial body of research. Therefore, multiple estimates can be found for given combinations of land cover types and ecosystem services. In these instances, we report both low and high per-acre value estimates. Other ecosystem services and land cover types are less well-researched. For cases where we have been unable to identify a study suitable for transfer to the Hale Parkway study area, we have not provided a value. It is important to understand that this decision simply reflects the limitations of valuation research, not that those natural assets provide no value.

To apply BTM for a full set of ecosystem service/land cover type combinations, this analysis used Earth Economics' Ecosystem Service Valuation Toolkit (EVT). Studies within EVT have gone through multiple reviews and are standardized for use in BTM. Our analysts used several criteria to select appropriate primary studies for the Hale Parkway study area, including geographic location and the ecological and demographic characteristics of the original primary study sites.

# OVERVIEW OF STUDY SITE
## HALE PARKWAY IMPROVEMENTS

Hale Parkway is a two-way, four-lane, diagonal roadway located in East Denver, bounded by 12th Ave to the north, 8th Ave to the south, Colorado Boulevard to the west, and Grape Street to the east. The residential and commercial areas surrounding Hale Parkway experience frequent surface flooding following heavy rains and rapid snow melt. Through a series of community engagement efforts, the Montclair Outfall System Plan study team identified Hale Parkway as a potential location for a much-needed stormwater facility that could also provide valuable community amenities. The proposed Hale Parkway Improvement Plan (HPIP) will shrink the width of the existing boulevard, converting the northern half of the road into a natural drainage channel with an elevated multi-use path to connect and extend existing amenities within Lindsley Park, a neighborhood park located on the north side of the parkway. In addition to a multi-use path and greenway, the proposed design will include a picnic area and community garden space. The natural drainage channel would be designed to move 877 cubic feet of stormwater per second, supplementing a 78-inch pipe currently located under the parkway, as well as the proposed additional 120-inch underground pipe.

**FIGURE 1** HALE PARKWAY PROJECT AVENUE



# VALUATION OF PROPOSED HALE PARKWAY IMPROVEMENT PLAN

This valuation uses BTM to estimate the baseline economic value of the existing Hale Parkway, the economic value of the proposed parkway installation, and the marginal increase in value associated with conversion of pavement and existing vegetated parkway medians into a green infrastructure community asset. The valuation of ecosystem service benefits has been pursued in two ways: based on land cover within the Parkway, and at the project scale. This section details the methodologies used for both valuation approaches.

## LAND COVER BASED ESTIMATION

The total value of some ecosystem services can best be estimated based on land cover types. This approach is most appropriate for ecosystem functions where per-unit productivity is less affected by scale, and total output can be adjusted by the extent of a given land cover type (a common proxy for ecosystem type). This approach was applied to air quality, carbon storage and sequestration, local temperature regulation, and habitat value. The following steps were taken to estimate ecosystem services using a land cover based approach.

### STEP 1
### IDENTIFYING AND QUANTIFYING LAND COVER

The first step to valuing the gain in ecosystem service value attributable to the HPIP was to identify and measure the extent of the land cover types in the Hale Parkway area as it currently exists, as well as after installation of the HPIP. The HPIP involves converting pavement and existing vegetated parkway medians to an integrated greenway, with both improved and expanded vegetation, as well as a new trail system. The extent of grasses, trees, shrubs, and pavement for both the baseline and post-installation scenarios were estimated using geospatial data provided by the Denver County Open Data Catalog, as well as detailed planting schemes provided by the Montclair Outfall Systems Plan study team. Table 1 shows the estimated land cover both before and after the Hale Parkway improvements. Figures 2 and 3 show the proposed land cover change from baseline to post-installation.

**TABLE 2** HALE PARKWAY PROJECT AVENUE

| LAND COVER TYPE | BASELINE ACRES | POST-INSTALLATION ACRES |
|---|---|---|
| Grass | 4.60 | 6.60 |
| Trees | 1.00 | 1.10 |
| Shrubs | 0.00 | 1.40 |
| Pavement | 8.70 | 5.20 |
| **TOTAL** | **14.3** | **14.3** |

**TABLE 3** GAP ANALYSIS FOR LAND COVER BASED ECOSYSTEM SERVICE VALUATION DATASET

| ECOSYSTEM SERVICE | GRASS | TREES | SHRUBS |
|---|---|---|---|
| PROVISIONING SERVICES | | | |
| FOOD | ● | ■ | ● |
| MEDICINAL RESOURCES | ○ | ○ | ○ |
| ORNAMENTAL RESOURCES | ○ | ○ | ○ |
| ENERGY AND MATERIALS | ○ | ○ | ○ |
| WATER STORAGE | ○ | ○ | ○ |
| REGULATING SERVICES | | | |
| AIR QUALITY | ● | ■ | ● |
| BIOLOGICAL CONTROL | ○ | ○ | ○ |
| CARBON STORAGE & SEQUESTRATION | ■ | ■ | ■ |
| LOCAL TEMPERATURE REGULATION | ● | ■ | ● |
| SOIL FORMATION | ○ | ○ | ○ |
| SOIL QUALITY | ○ | ○ | ○ |
| SOIL RETENTION | ○ | ○ | ○ |
| WATER QUALITY | ○ | ○ | ○ |
| WATER CAPTURE, CONVEYANCE, AND SUPPLY | ○ | ○ | ○ |
| NAVIGATION | ○ | ○ | ○ |
| FLOOD RISK REDUCTION | *VALUED ON INSTALLATION-LEVEL* | | |
| SUPPORTING SERVICES | | | |
| HABITAT & NURSERY | ● | ■ | ■ |

■ Valued in this assessment

● Value exists, but not valued due to data limitations

○ Not relevant to project context

**FIGURE 2** BASELINE SCENARIO LAND COVER


**FIGURE 3** POST-INSTALLATION SCENARIO LAND COVER

## STEP 2
## IDENTIFY AND VALUE ECOSYSTEM SERVICES

Next, for each land cover type, the ecosystem services provided by that land cover were identified. For example, trees are a significant element of the proposed Hale Parkway installation. Each square foot covered by tree canopy provides a suite of ecosystem services (e.g. air quality, local temperature regulation, habitat and nursery). Earth Economics then valued these services using BTM (describe in the previous section). Table 2 reports those ecosystem services which could be valued, by land cover type.

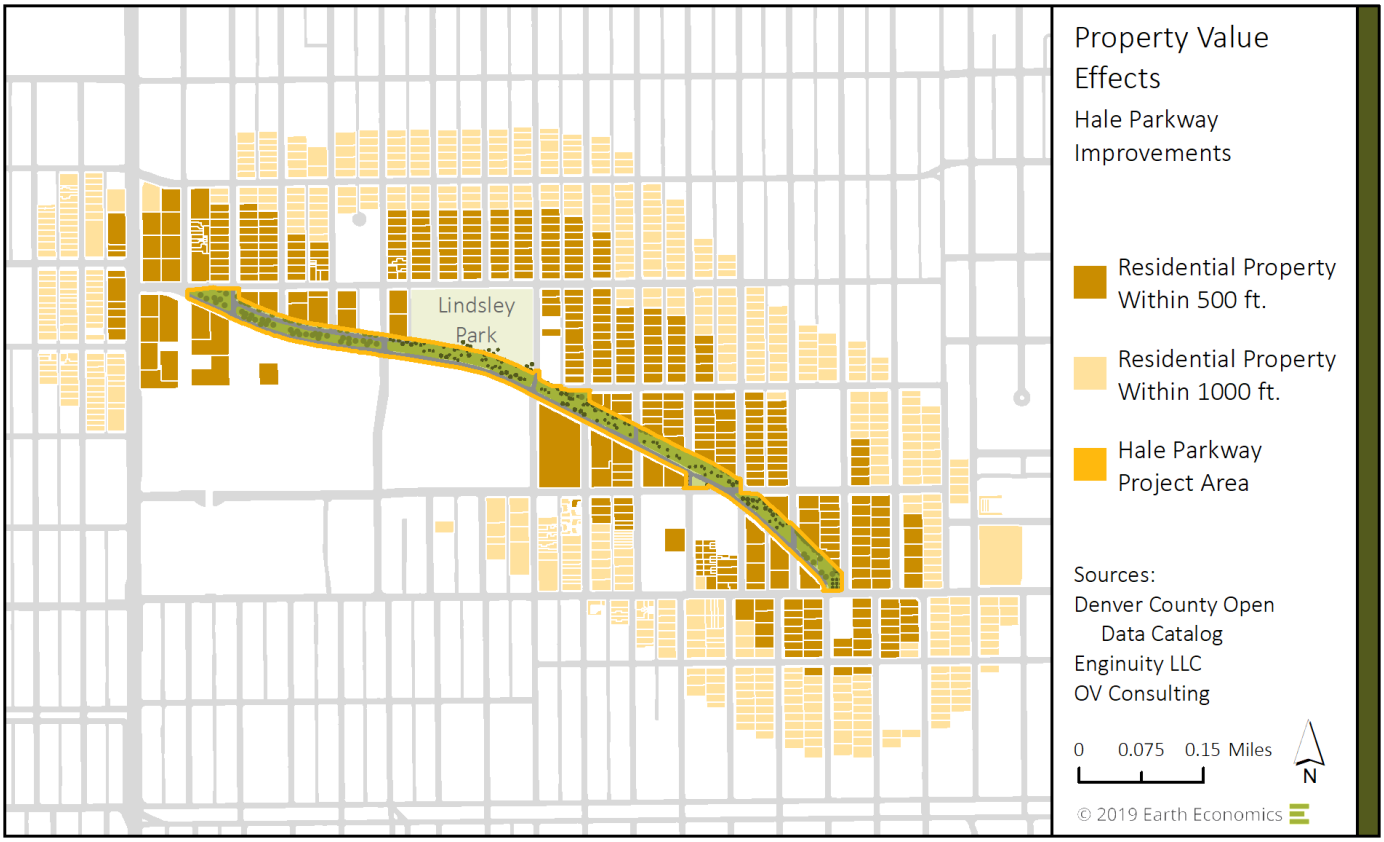
## STEP 3
## ESTIMATE ANNUAL VALUE OF HALE PARKWAY ECOSYSTEM SERVICES BY LAND COVER

The annual ecosystem service contributions provided by each acre of each land cover type was then scaled to the extent of that land cover within the study area, to estimate the total annual contribution of ecosystem services for both the baseline and post-installation scenarios. The difference in these annual contributions is the marginal change in value provided by the Hale Parkway improvements. These were then combined to show the total annual value contributed by ecosystem services to the local community under each scenario, as well as the additional expected contribution of the Hale Parkway improvements.

**TABLE 4** ANNUAL ECOSYSTEM SERVICE VALUES ASSOCIATED WITH EACH SCENARIO, BY LAND COVER

| | **BASELINE SCENARIO** *VALUE PER YEAR* | | **POST-INSTALLATION** *VALUE PER YEAR* | | **MARGINAL GAIN** *VALUE PER YEAR* | |
|---|---|---|---|---|---|---|
| | Low | High | Low | High | Low | High |
| Grass | $1,021 | $1,605 | $1,467 | $2,305 | $446 | $700 |
| Trees | $12,075 | $13,633 | $12,138 | $13,696 | $63 | $63 |
| Shrubs | $0 | $0 | $399 | $1,204 | $399 | $1,204 |
| Total | $13,097 | $15,238 | $14,004 | $17,205 | $907 | $1,967 |

**FIGURE 4** PROPERTY VALUE BENEFITS OF HALE PARKWAY IMPROVEMENTS



# INSTALLATION-LEVEL ESTIMATION

For ecosystem services which are more (or less) valuable depending on the scale or accessibility, it is more appropriate to estimate benefits at the full-project level. For example, recreational or aesthetic benefits often depends on accessibility, intended use, and spatial context. Similarly, the value of flood risk reduction provided by the project improvements will depend on the overall design and engineering of the open channel facility, rather than the mere combination of land cover types comprising the improvements. For this assessment, property value benefits, recreational benefits, health benefits, and flood risk mitigation benefits have been estimated on the project level. Benefits were estimated for the baseline (existing) Hale Parkway area and compared to the estimated increase in benefits generated by the proposed improvement plan. While benefits can be attributed to the Hale Parkway area as it currently exists, we can estimate additional community benefits associated with the HPIP by examining how the proposed amenities supplement and expand upon the existing amenities at Lindsley Park.

It should be noted that the baseline level of benefit provided by the existing parkway is dependent on how the benefits were defined and measured. For example, while nearby residents do not currently recreate in the Hale Parkway area (as confirmed by anecdotal evidence collected via conversations with residents at public meetings), it can be assumed that these residents participate in some baseline level of recreational activity in general, and that installing the HPIP would serve to increase their level of activity above and beyond what they currently enjoy. In this case, we have assigned a positive dollar value to the baseline level of recreational activity occurring among Hale Parkway residents, to reflect general recreation activity among residents regardless of where the activity occurs. In contrast, while the existing vegetation along Hale Parkway medians likely provides some level of flood risk mitigation (due to tree canopy interception with rainfall and absorption of stormwater from existing grass and shrubs), we have defined the baseline flood mitigation value as zero dollars, as we only have data on estimated 100-year flood damages to surrounding properties based on the existing Hale Parkway layout and do not have data on how much worse flood damage during a 100-year event would be without the existing vegetated medians along the Parkway. In both cases, we have selected the best available approach to estimating baseline benefits, based on data availability and methodological constraints.

## PROPERTY VALUE BENEFITS

**OVERVIEW** In addition to ecosystem services such as air quality and habitat, green infrastructure such as the Hale Parkway improvements can also bolster residential property values for nearby homes. Studies show that properties adjacent to green spaces and attractive views have higher market value when compared to other locations. The aesthetic contribution of green infrastructure can be estimated based on what consumers are willing to pay for proximity to such amenities, as revealed in real estate pricing. The scholarly literature suggests that green infrastructure can increase nearby property values by 2 to 4 percent,[13, 14, 15, 16, 17] and that the majority of this increased value occurs for homes located within 500 feet, but can be detected for homes up to 2000 feet away.[18]

**APPROACH AND RESULTS** To understand the contribution of the Hale Parkway Improvements to local real estate, we identified all residential properties within 500 and 1000 feet of the existing Lindsley Park or the proposed parkway project. We assumed that properties already within the area of influence of Lindsley park would still see increased value as a result of the Hale Parkway Improvements. The conservative 500 to 1000-foot buffer was used to ensure the analysis did not overstate the project's effect on residential property values. A 3.14% attribute rate[i] was applied to assessed property values among the selected properties (obtained through Denver Open Data Catalog), and the marginal gain in property value was annualized based on the likely increase in rental income that homeowners would enjoy as a result of increased property value (approximately 1% of average property value per month).[19] While benefits directly accrued to local government were excluded from this analysis, it should be noted that these increases in property values would generate additional property tax revenue for the City of Denver (an estimated $48,086 to $185,290 each year, based on the city's property tax rate). The total increase in property values is estimated at **$715,567 to $2,757,291** each year, as a result of the Hale Parkway improvements.

[i] A 3.14% attribute rate is averaged from multiple studies examining property value effects of low impact development/green infrastructure projects, including: Ward et al 2008, Shultz and Schmitz 2008, Wachter and Wong 2006, Anderson and Cordell 1988, and Braden and Johnston 2003.

## RECREATIONAL BENEFITS

**OVERVIEW** Neighborhood parks have been shown to encourage increased levels of physical activity among nearby residents.[6] Previous research conducted on recreation patterns following park improvements has shown that overall park use within a ½ mile radius of the newly renovated park increases by 11%, and physical activity increases by 5%.[20] Other estimates show much greater increases in park use, especially neighborhood parks with walking loops and trail amenities,[21] though the study sites are not comparable to Hale Parkway.[22]

The value of recreating at a park can be estimated in monetary terms by measuring a consumer's surplus. Consumer surplus is calculated by estimating a park visitor's willingness to pay for recreation and subtracting the actual cost incurred. For example, assume a Hale Parkway neighborhood resident is willing to pay $20 to spend an afternoon at the Hale Parkway facility. If it only costs the resident $5 to travel to the park, the consumer surplus for that park visitor is $15.

**APPROACH AND RESULTS** We estimated the existing recreation levels and consumer surplus value among neighborhood residents residing within a half mile radius of the proposed Hale Parkway Improvements project area, which is the average service area for a neighborhood park in Denver. The number of residents residing within a half-mile radius of the project area was estimated using census tract-level population data, parcel data, and dasymetric mapping techniques in ArcGIS. Since consumer surplus studies have not been conducted on Denver neighborhood parks specifically, we utilized consumer surplus values from studies that value recreation at similar regional parks throughout United States.[23, 24, 25] Consumer surplus values were identified for the set of activities that would likely occur in the Hale Parkway Improvements area, including walking, jogging/running, picnicking, and biking. Baseline recreational activity levels among neighborhood residents were estimated by activity type, from Colorado Parks and Wildlife 2019 Statewide Comprehensive Outdoor Recreation Plan. Table 4 summarizes the estimated recreation participation levels among residents within the park service area and the consumer surplus values associated with these activities.

We conservatively assumed a 5-10% increase in recreation participation levels among service area residents in the Hale Parkway post-installation scenario.[ii] This results in a total marginal increase of consumer surplus value of **$152,527 to $305,055 per year**.

ii While Cohen et al 2010 find an 11% increase in overall recreation levels after installment of neighborhood parks, the study took place in an area with different socioeconomic characteristics, and the direct transferability of the 11% increase rate to the Hale Parkway area is uncertain. We therefore constructed a 5-10% range to avoid overestimating the effects of the new Hale Parkway project on recreation levels.

**TABLE 5** BASELINE SCENARIO LAND COVER

| ACTIVITY | CURRENT RECREATION PARTICIPATION LEVELS WITHIN PARK SERVICE AREA | AVERAGE CONSUMER SURPLUS VALUE PER PERSON-DAY |
|---|---|---|
| Walking | 104,854 | $20 |
| Jogging/Running | 27,884 | $20 |
| Picnicking | 12,973 | $24 |
| Road Biking | 7,292 | $12 |

## HEALTH BENEFITS

**OVERVIEW** Park systems contribute to the overall health and wellness of surrounding communities. From mental health benefits, to increased community cohesion, to improved cardiovascular health associated with higher physical activity levels, ample evidence exists demonstrating the significant social and public health benefits that park systems generate for users. The health benefits associated with physical activity and reduced rates of heart disease, obesity, and other health problems can be estimated in monetary terms, using census tract-level data on insufficient physical activity levels and studies that estimate the cost of physical inactivity. For example, drawing on health studies from seven states, the Trust for Public Land attributed an average value of $351 in medical savings for adults who regularly exercise in parks.[26] The standards for exercise were based on the U.S. Centers for Disease Control and Prevention recommendation of 30 minutes of moderate exercise five times a week or 20 minutes of vigorous exercise at least three times a week for adults.

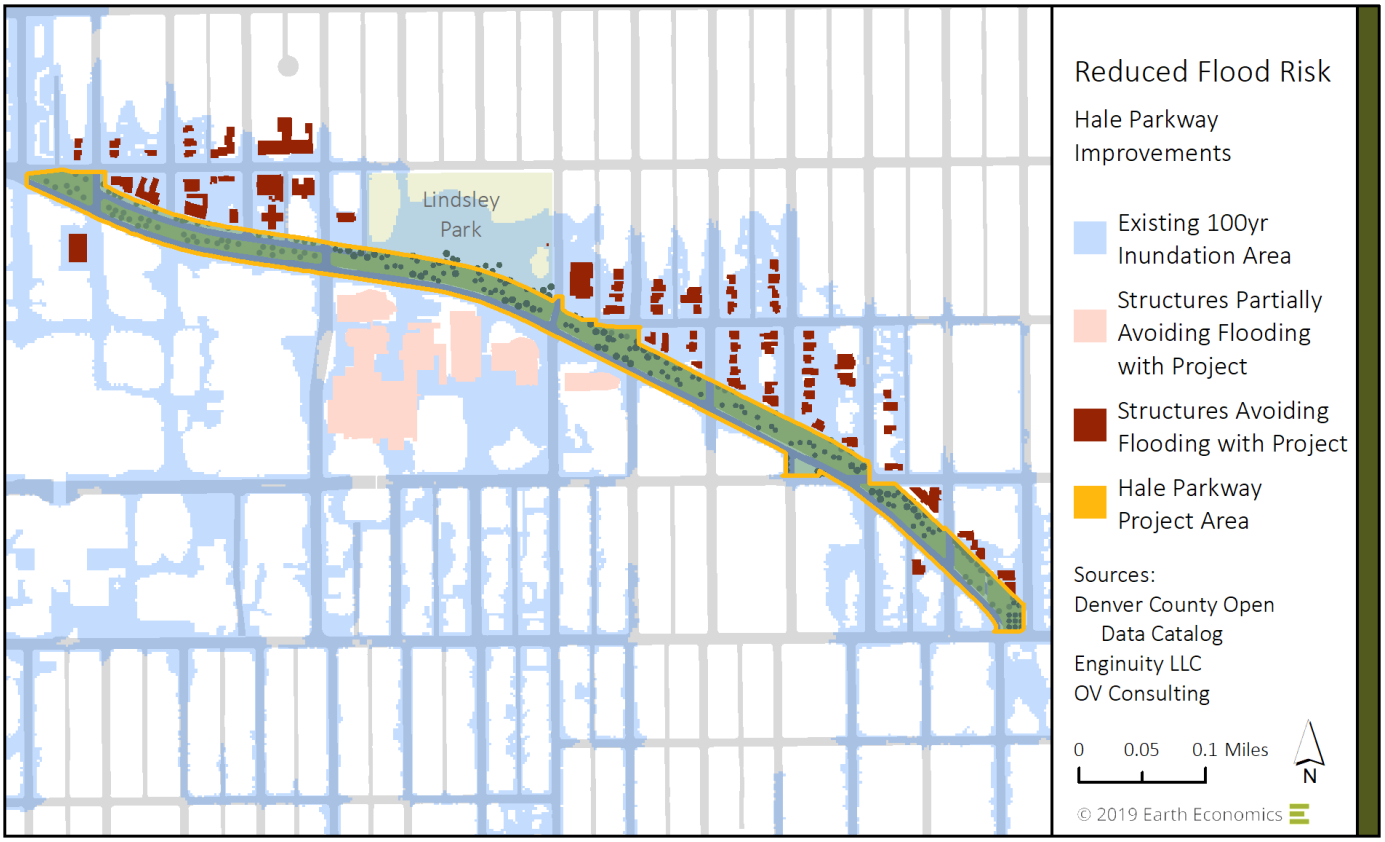
**APPROACH AND RESULTS** Drawing on assumed increases in recreation participation levels resulting from the Hale Parkway Improvements, national estimates of the medical cost of inactivity and obesity among adults,[27] and census tract-level data on physical activity levels among adults, we estimated the avoided health care costs enjoyed by park system users associated with a 5-10% increase in recreation. We conservatively assumed that half of the new recreation generated from the Hale Parkway Improvements project (2.5% to 5%) would result in physical activity that meets federal guidelines for cardiovascular health, based on research examining contribution of new park systems to physical activity levels among adults.[10] This results in an estimated **$138,388 to $276,777** in additional avoided medical costs each year, as a result of the Hale Parkway project.

## FLOOD RISK MITIGATION BENEFITS

**OVERVIEW** One of the major benefits of green stormwater infrastructure such as the vegetated open channel proposed as part of the Hale Parkway improvements is reduced street flooding. Street flooding results in significant property damage, depending on the depth of flooding and replacement value of impacted properties. Paired with flood modeling and property elevation data, the FEMA flood depth-damage curve can be used to estimate the likely cost of flood-related property damage associated with a severe storm event. While property damage can occur from a range of different flood events (5-year flood, 10-year flood, 100-year flood, etc), we only looked at damages associated with a 100-year flood event, given that the Hale Parkway improvements are specifically designed to convey a 100-year flood event.

**APPROACH AND RESULTS** Depth-damage estimates for a 100-year flood event in the Hale Parkway area were obtained from the Montclair Basin Outfall Systems Plan, which utilizes a 2-dimensional flood analysis to determine anticipated flood depths along the Parkway. The total 100-year flood damage value for the affected buildings along Hale Parkway is $67,787,744. Most of the damage value is associated with three hospital buildings along the south side of the parkway. Although the Parkway improvements will partially benefit these three properties, the improvements alone will likely not eliminate the flood damage potential for the hospital structures. Additional storm drain improvements extending to the south would be required to further benefit the hospital. However, the remaining affected residential buildings combine to a damage value of $6,601,647. The Hale Parkway improvements will generally remove these structures from 100-year flood damage. The total avoided flood damages to residential structures can be annualized over the 100-year period, resulting in an estimated average of **$66,016 in avoided flood damage each year**.

**FIGURE 5** STRUCTURES BENEFITING FROM AVOIDED FLOOD DAMAGE AS A RESULT OF HALE PARKWAY IMPROVEMENTS



# VALUATION
# RESULTS

## TOTAL ANNUAL VALUE OF HALE PARKWAY IMPROVEMENTS

The total annual economic value associated with the baseline scenario is $20.3 million to $85.3 million (average value of $52.8 million), while the total annual economic value associated with the Hale Parkway Improvements is $21.3 million to $88.6 million (average value of $55.0 million). This results in a marginal increase of **$1.1 million to $3.4 million in annual value**, or an average of **$2.2 million in annual value**. The total values for each scenario and marginal increase associated with the improvements in summarized below.

**TABLE 6** ANNUAL ECONOMIC VALUE OF PRE- AND POST-INSTALLATION SCENARIOS

| BENEFIT | BASELINE SCENARIO *VALUE PER YEAR* | | | POST-INSTALLATION *VALUE PER YEAR* | | | MARGINAL GAIN *VALUE PER YEAR* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Low | Average | High | Low | Average | High | Low | Average | High |
| Air Quality | $1,178 | $1,178 | $1,178 | $1,914 | $1,914 | $1,914 | $736 | $736 | $736 |
| Carbon Storage & Sequestration | $10,818 | $11,888 | $12,959 | $10,901 | $12,109 | $13, 318 | $83 | $221 | $359 |
| Local Temperature Regulation | $481 | $481 | $481 | $503 | $503 | $503 | $22 | $22 | $22 |
| Habitat and Nursery | $620 | $620 | $620 | $687 | $1,079 | $1,471 | $67 | $459 | $851 |
| Property Values | $22,788,758 | $55,300,283 | $87,811,808 | $23,504,325 | $57,036,712 | $90,569,099 | $715,567 | $1,736,429 | $2,757,291 |
| Recreation Use Value | $3,050,547 | $3,050,547 | $3,050,547 | $3,203,075 | $3,279,338 | $3,355,602 | $152,527 | $228,791 | $305,055 |
| Health Costs | ($5,535,534) | ($5,535,534) | ($5,535,534) | ($5,397,145) | ($5,327,951) | ($5,258,757) | $138,388 | $207,583 | $276,777 |
| Avoided Flood Damage | ($66,016) | ($66,016) | ($66,016) | $0 | $0 | $0 | $66,016 | $66,016 | $66,016 |
| TOTAL | $20,250,852 | $52,763,448 | $82,276,043 | $21,324,259 | $55,003,704 | $88,683,150 | $1,073,407 | $2,240,256 | $3,407,106 |

## ASSET VALUE OF THE HALE PARKWAY IMPROVEMENTS

The asset value of built capital, such as a road, levee, home, or business, can be calculated as the net present value of its expected future benefits. In the same way that a home holds value year after year, natural capital improvements such as the Hale Parkway Improvements also provide value over time. The annual flow of ecosystem services presented above will persist into the future, and communities will continue to benefit from the Hale Parkway Improvements for many years to come. Analogous to built capital, we calculate the asset value of natural capital in the Hale Parkway Improvements project.

The asset value calculated in this analysis is based on a snapshot of the current land cover and available valuation literature. It provides a measure of the expected benefits flowing from the study area's natural capital over time. The net present value formula is used to compare benefits that are produced at various points in time. In order for this to be accomplished, a discount rate must be used.

Discounting allows for sums of money occurring in different time periods to be compared by expressing the values in present terms. In other words, discounting shows how much future sums of money are worth today. Discounting is designed to take two major factors into account:

- **TIME PREFERENCE**
  People tend to prefer consumption now over consumption in the future, meaning a dollar today is worth more than a dollar received in the future.
- **OPPORTUNITY COST OF INVESTMENT**
  Investment in capital today provides a positive return in the future but renders those funds unavailable for other investment opportunities.

However, experts disagree on the appropriate discount rate for natural capital benefits. Public and private agencies vary widely in their standards for discount rates. The Office of Management and Budget (OMB) recommends a 7% rate for average investments, while the Army Corps of Engineers (ACOE) currently uses a 2.75% rate for water related projects.[28] The choice of discount rate is critical, however, as influences the outcome of the present value of benefits which occur over a long period of time. Lower discount rates better demonstrate the value of long-term assets, as benefits many years into the future are discounted at a smaller rate. Earth Economics recommends using a 2.75% for natural capital asset valuations, consistent with current ACOE guidance for water projects.[29]

Present values can be calculated over different timeframes depending on the purpose of the analysis and the nature of the project. In the case of natural capital valuations, ecosystems, if kept healthy, show long-term stability and productivity. Although many built capital projects are valued for shorter timespans, we chose a 50-year timeframe to reflect the longevity of natural capital's stability and productivity. The net present value of marginal benefits over 50-year period for the Hale Parkway improvements is **$29 million to $92 million** (average value of $60 million) using a 2.75% percent discount rate, and **$54 million to $170 million** (average value of $112 million) using a 0% discount rate.

**TABLE 7** NET PRESENT VALUE (NPV) OF HALE PARKWAY IMPROVEMENTS BENEFITS

| DISCOUNT RATE | NPV OF HALE PARKWAY IMPROVEMENTS | | | NPV OF MARGINAL BENEFITS FROM HALE PARKWAY IMPROVEMENTS | | |
|---|---|---|---|---|---|---|
| | Low | Average | High | Low | Average | High |
| 0% | $1,066,212,939 | $2,794,526,782 | $4,522,840,625 | $53,670,333 | $112,012,819 | $170,355,304 |
| 2.75% | $575,694,639 | $1,529,285,925 | $2,482,877,211 | $28,978,942 | $60,480,582 | $91,982,222 |

# ADDITIONAL BENEFITS AND **CONSIDERATIONS**

This assessment quantified in monetary terms a subset of the range of benefits generated by the proposed Hale Parkway Improvements project. Of course, the value of greenery and outdoor space means many things to many people, and much of that value is beyond economic measure. This section discusses some of the additional benefits not captured in the valuation above, due to data and/or methodological limitations.

## NEIGHBORHOOD CONNECTIVITY AND ECONOMIC VALUE

The Hale Parkway Improvements will not only provide recreational amenities but will also improve the connectivity of the neighborhood overall, through construction of a new trail as well as the addition of crosswalks and improved traffic flow along the parkway. Encouraging increased time spent outdoors and improving connectivity of the neighborhood may generate additional economic activity among neighboring businesses, as park use increases and ability to connect to the north and south sides of the parkway improves. Improved transportation networks through the creation of new trail systems has been shown in other communities to improve connections among homes, workplaces, schools, and businesses, and there are many examples of new urban parks and trail systems generating significant consumer spending among neighborhood businesses, which in turn supports local wages and local tax revenue.[30] The creation of new park space and trail systems can also attract new business to the neighborhood, further bolstering local economic activity.[25, 26]

## COMMUNITY COHESION AND WELLBEING

Green infrastructure projects that include public outdoor space, such as the proposed Hale Parkway Improvements, have been shown to increase community cohesion, defined as the networks of formal and informal relationships among neighborhood residents that foster a nurturing and mutually supportive social environment.[32] Community gathering spaces can improve community cohesion and wellbeing through fostering social interactions, generating a shared sense of community and social support, and mitigating social isolation.[33] Studies have shown that the more community stakeholders are involved in the design and planning process, the more likely a new outdoor space amenity will be actively used and achieve desired social outcomes.[34] Green infrastructure has also been show to improve mental health and wellbeing, including improved mood and lower levels of anxiety, depression, and stress.[35] Exposure to nature improves cognitive performance and alleviates mental fatigue, leading to improved work productivity[36] and less violent domestic environments.[37] Urban greenery has also been linked to reductions in the neighborhood crime.[38, 39]

## EDUCATION

Green infrastructure facilities can provide educational opportunities for the public, especially those with public education features such as interpretive signage.[40] Natural areas can also serve as a destination for school fieldtrips -- schools are more likely to arrange for outdoor excursions when located in close proximity to green space.[41] Time spent in urban parks has been shown to improve children's connection to the natural environment and foster a sense of environmental stewardship.[42] Studies suggest that exposure to nature and the outdoors also improves analytical thinking and spatial working memory of children[43] and that the informal, experiential learning through play and shared experiences with peers can improve overall effectiveness of formal classroom education.[44]

## EQUITY CONSIDERATIONS

When considering the economic benefits of a green infrastructure park such as the Hale Parkway Improvements project, it is important to examine the distribution of those benefits – that is, who is benefitting, and at what cost. Public investments in urban greenery and park space often attract development and generate increases in property values,[45] as characterized in this report. While rising property values can result in real economic benefit to homeowners, increased home values often lead to the displacement of underserved and underrepresented residents—and underserved and underrepresented residents of color, specifically—as renters face rising rents, property taxes increase, homeowners face pressure to sell to make way for new developments, and local businesses and culturally relevant services are priced out.[46] This pattern of displacement of underserved and underrepresented families, as cities embrace nature-based solutions to stormwater management and other resilience goals, perpetuates structural inequities across race and income.[46] Housing regulation, inclusionary zoning, and value capture mechanisms that allow for a portion of private sector returns to be acquired and directed toward local reinvestment, are examples of potential solutions to mitigate this phenomenon and ensure that the benefits generated by natural capital are shared by all.[47, 48]

# ADDITIONAL BENEFITS AND **CONSIDERATIONS**

This report provided an overview of the community benefits and ecosystem services associated with the proposed Hale Parkway Improvements and estimated in monetary terms the marginal economic value associated with the proposed project. The proposed multi-purpose community asset for Hale Parkway will generate a number of ecosystem services, including regulating services such as air quality purification, carbon storage and sequestration, and urban heat island effect mitigation, supporting services such as habitat provision, and additional community benefits such as property value uplift, recreation and physical health, mental health, educational value, and community cohesion. Upon completion of the Hale Parkway Improvements, the Hale Parkway community will enjoy a marginal increase of $1.1 million to $3.4 million in economic value each year (average value of $2.2 million), across eight ecosystem services categories. Over a 50-year time period, this amounts to $29to $92 million in benefits, using a 2.75% discount rate.

This analysis demonstrates the significant additional value generated by the proposed Hale Parkway improvements, above and beyond the existing value of the current Hale Parkway area. A green stormwater infrastructure project that doubles as a community asset enhances community resilience and wellbeing and the return on investment to the local community. Economic valuations of proposed storm water projects, when applied as a standard part of cost-benefit analysis and project selection, can illuminate the greater community value generated by green storm water infrastructure alternatives, particularly projects such as Hale Parkway that serve as a valuable community amenity.

# APPENDIX A
# STUDY LIMITATIONS

The benefit transfer method (BTM), used in this study to value ecosystem services, has limitations. Yet, these limitations should not detract from the core finding that ecosystems produce significant economic value for society. Some limitations include:

- Every ecosystem is unique; per-acre values derived from another location may be of limited relevance to the ecosystems under analysis.
- Even within a single ecosystem, the value per acre depends on the size of the ecosystem; in most cases, as the size decreases, the per-acre value is expected to increase, and vice versa. (In technical terms, the marginal cost per acre is generally expected to increase as the quantity supplied decreases; a single average value is not the same as a range of marginal values).
- Gathering all the information needed to estimate the specific value for every ecosystem within the study area is not currently feasible. Therefore, the full value of all of the shrubland, grassland, et cetera in a large geographic area cannot yet be ascertained. In technical terms, far too few data points are available to construct a realistic demand curve or estimate a demand function.
- The prior studies upon which calculations are based encompass a wide variety of time periods, geographic areas, investigators, and analytic methods. Many of them provide a range of estimated values rather than single-point estimates. The present study preserves this variance; no studies were removed from the database because their estimated values were deemed too high or too low. In addition, only limited sensitivity analyses were performed. This approach is similar to determining an asking price for a piece of land based on the prices of comparable parcels ("comps"): Even though the property being sold is unique, realtors and lenders feel justified in following this procedure to the extent of publicizing a single asking price rather than a price range.
- In response to the study by Costanza et al. (1997) of the value of all of the world's ecosystems, critics objected to the absence of imaginary exchange transactions. However, including exchange transactions is not necessary if one recognizes the purpose of valuation at this scale—a purpose that is more analogous to national income accounting than to estimating exchange values.[49]

This report displays study results in a way that allows one to appreciate the range of values and their distribution. It is clear from viewing the tables that the final estimates are not precise. However, they are much better estimates than the alternative of assuming that ecosystem services have zero value, or, alternatively, of assuming they have infinite value. Pragmatically, in estimating the value of ecosystem services, it is better to be approximately right than precisely wrong.

# APPENDIX B
# VALUE TRANSFER STUDIES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