



National Disaster Resilience Competition (NDRC)

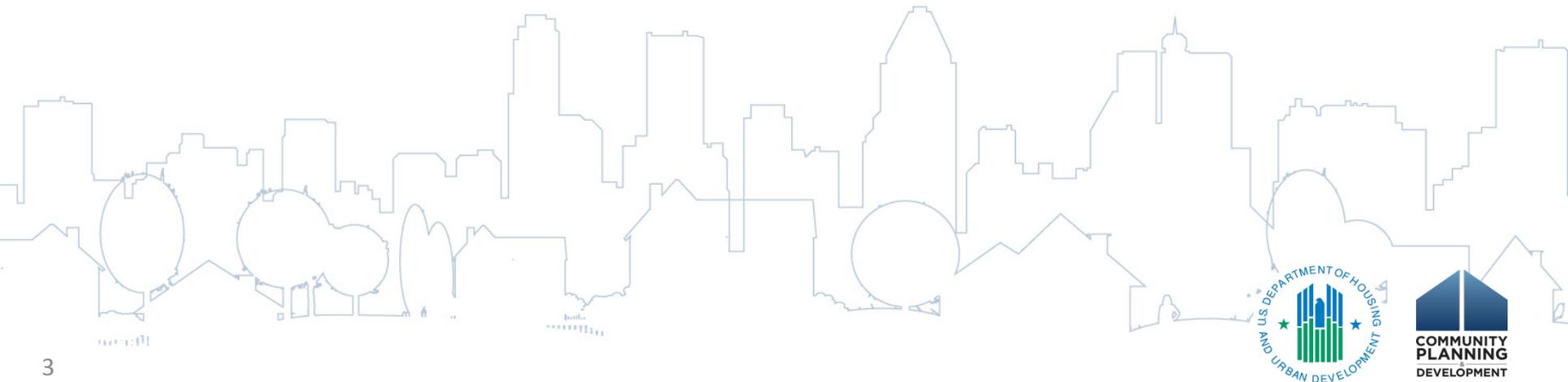
Benefit Cost Analysis: Appendix H

Presenters

- Allison Heck – Presidential Management Fellow, FEMA, Office of Policy and Program Analysis, Policy Division (Currently on rotation with HUD Office of Economic Resilience)
- Sara Jensen – HUD Office of Environment and Energy

Agenda

1. Overview: National Disaster Resilience Competition
2. Benefit Cost Analysis (BCA): Appendix H
3. Connections between Appendix H and the rest of the Phase 2 Application
4. Resources and How to Ask Questions



2-Phase competition

Phase 1

[Framing Unmet Recovery Needs, Vulnerabilities, and Community Development Objectives]



Phase 2

[From Framing to Implementation]



*Note: These dates are tentative and subject to change at HUD's discretion.



Appendix H –Benefit Cost Analysis

Attachment H – Phase 2 Benefit-Cost Analysis (BCA) Instructions for Community Development Block Grant National Disaster Resilience (CDBG-NDR) Applicants

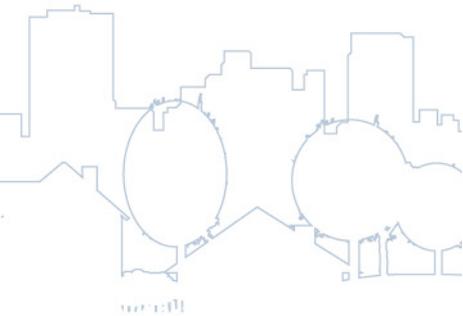
In Phase 2, each applicant will complete a benefit cost analysis for any Covered Projects. This CDBG-NDR BCA will provide a sense of the cost efficiency of the proposal, but the BCA score will not be used alone to determine soundness of approach. HUD will not fund any Phase 2 activities for which the benefits to the applicant’s community and to the United States as a whole are not demonstrated by the evidence submitted to justify the costs. The standard criterion for funding projects is a net present value above zero (or equivalently, a benefit-to-cost ratio greater than one). However, HUD recognizes that some benefits and costs may be difficult or impossible to quantify, and qualitative descriptions of benefits that cannot be monetized will be taken into account as evidence, as appropriate. Note that quantifying or otherwise accounting for social and ecological benefits and costs is a critical component, as is consideration of all related resources, including leverage. The methodology employed must follow OMB Circular A-94, “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs” (link below).

NOTE: The NDRC NOFA prevails if anything in this presentation conflicts or appears to conflict with the NOFA.



What is a Benefit Cost Analysis?

Consideration of the total costs and benefits of a project in present dollar value over the useful life of the proposal



What is a Benefit Cost Analysis?

Results in either a **Benefit-Cost Ratio (BCR)**

$$\text{Benefit/Cost} = \text{BCR}$$

Or a **Net Present Value (NPV)**

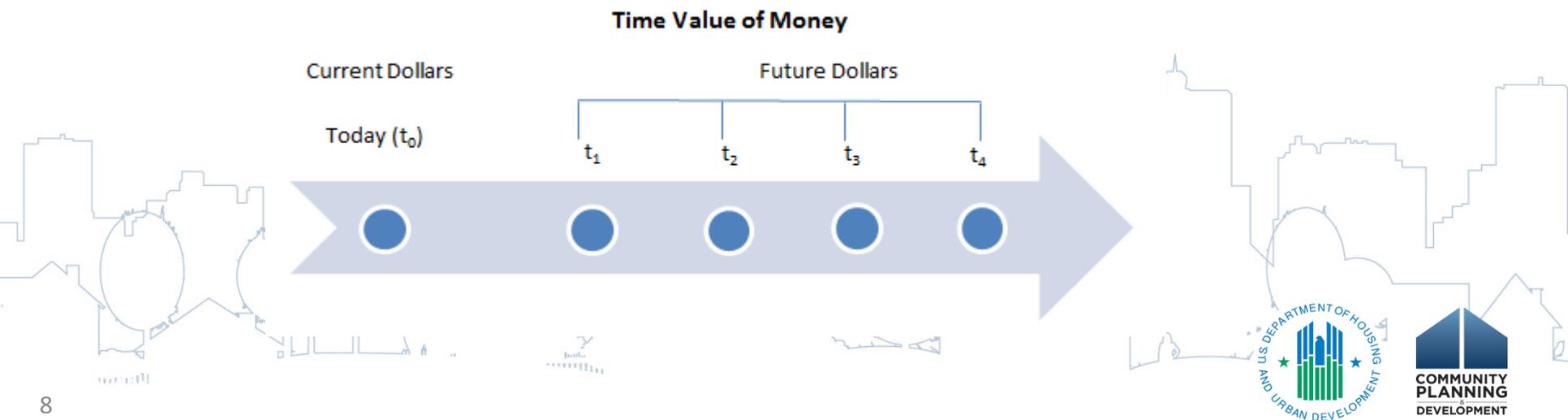
$$\text{Benefits} - \text{Costs} = \text{NPV}$$

Results	Kilchis River Crossings	Wilson River Intertie	Total Project
Benefits	\$900,621	\$4,204,988	\$5,105,609
Costs	\$696,956	\$365,399	\$1,062,355
BCR	1.29	11.51	4.81

Discount Rates-Time Value of Money

Present dollar value must consider the time value of money

Benefits and costs are worth more if they are experienced sooner



Discount Rate

- Applicants **must** use the base-case discount rate in OMB circular A-94 of 7%
- Applicants may additionally calculate benefits and costs using alternate discount rates (no lower than 3%) if they include justification acceptable to HUD.

Why do a Benefit Cost Analysis?

BCA required for a covered project.

- Covered Project: major infrastructure project or two or more related infrastructure projects having an estimated total cost (or combined total cost) of \$50 million or more (including at least \$10 million of CDBG-DR or CDBG-NDR funds)

Elements of Appendix H required for all projects.

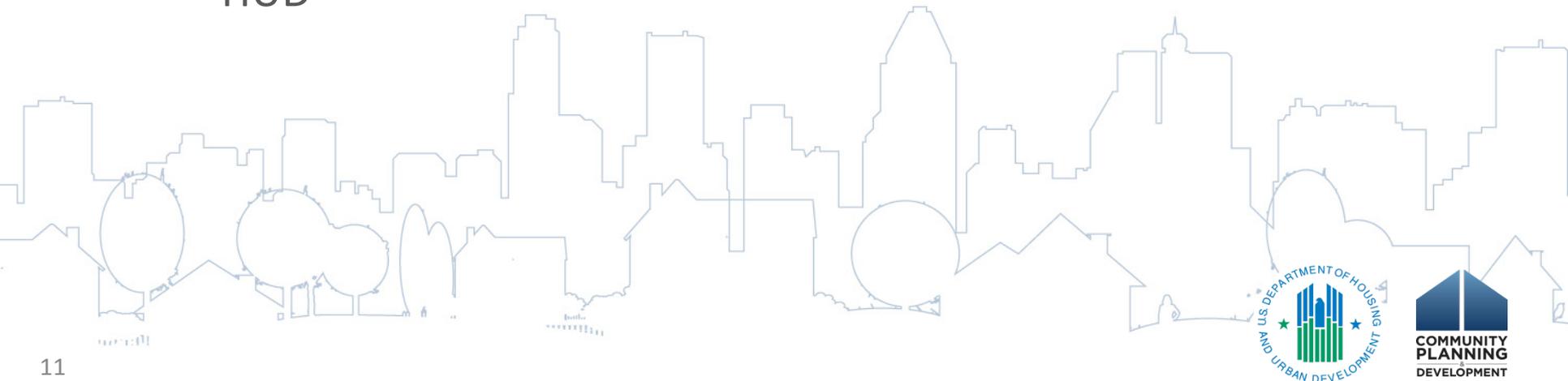
- All Phase 2 applications must submit outcome metrics based on Appendix H. Track at least one metric per category:

Resilience Value;
Environmental Value;
Social Value; and
Economic Revitalization

Why do a Benefit Cost Analysis?

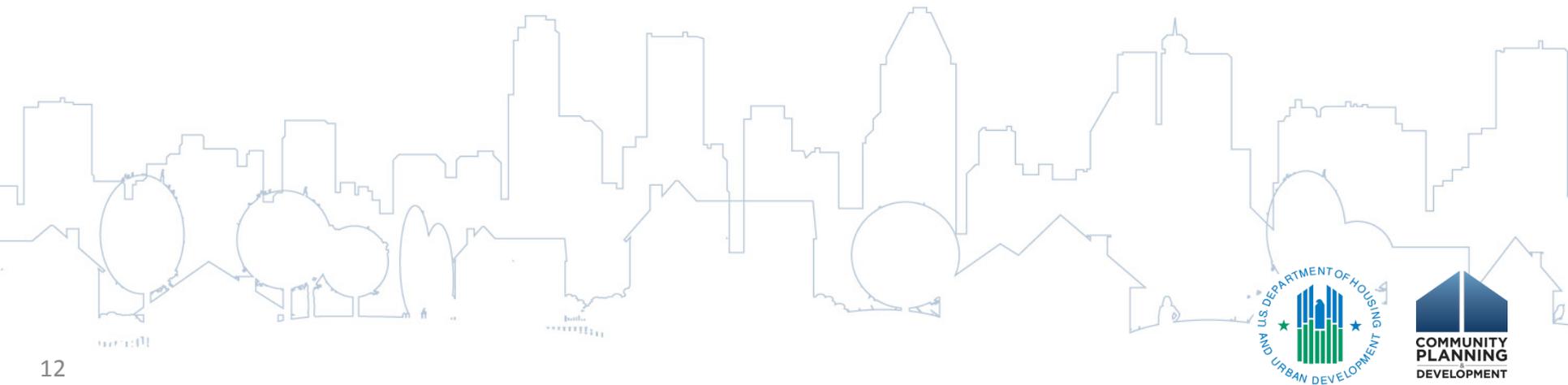
BCA encouraged for all projects.

- If project involves a wetland or floodplain or other federal funds, FEMA, DOT or USACE may require BCA
- Work on a BCA can help with environmental review requirements
- A BCA is another tool to show benefit of your project to HUD



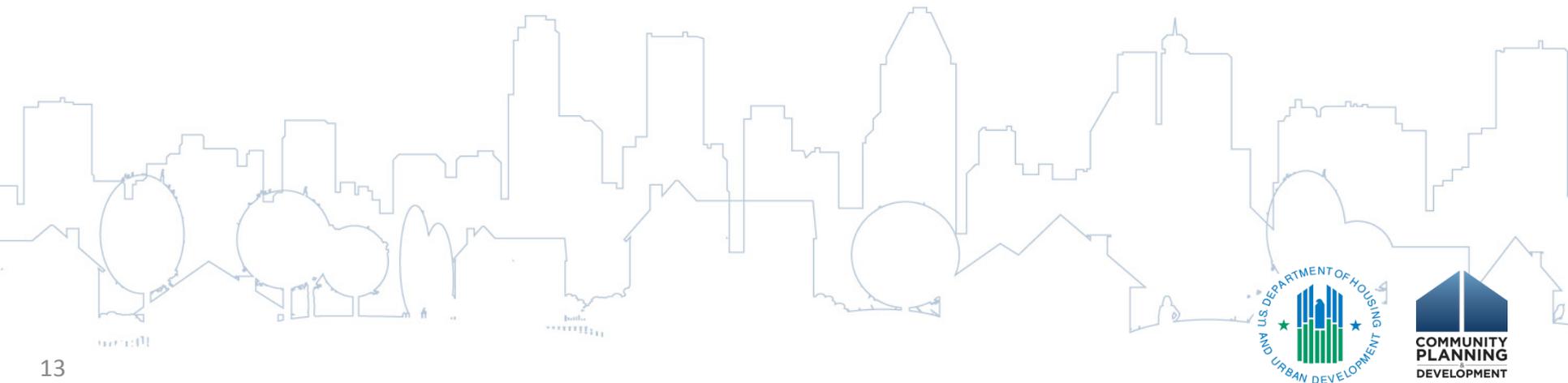
What is HUD looking for?

- HUD and citizens will better understand how applicants value the community development and economic revitalization benefits CDBG funds are provided to generate



What is HUD looking for?

- HUD will not fund any Phase 2 activities for which the benefits to the applicant's community and to the United States as a whole are not demonstrated by the evidence submitted to justify the costs.



NDRC NOFA Benefit Cost Analysis

Quantitative

- Benefit Costs Analysis that follows OMB Circular A-94 *
- Narrative Description that is clear, concise, evidence-based quantified, and designed for reviewers with limited economic background
 - Narrative Description includes a required table describing benefits and costs

Qualitative

- Three pages summarizing benefits or costs that are difficult to quantify

Using an Existing BCA

- HUD will accept an existing BCA that has been accepted by USACE, FEMA or DOT provided that:
 1. The BCA is based on the project as presented in the CDBG-NDR application;
 2. The BCA accounts for economic revitalization and other social/community benefits
 3. The BCA shows how analysis would change if HUD partially funds the application
 4. Applicant justifies using a modified discount rate.

Note: If discount rate or assumptions different from Appendix H, applicant must run a version that meets HUD requirements. This could be part of sensitivity analysis.



Multiple Components or Phases

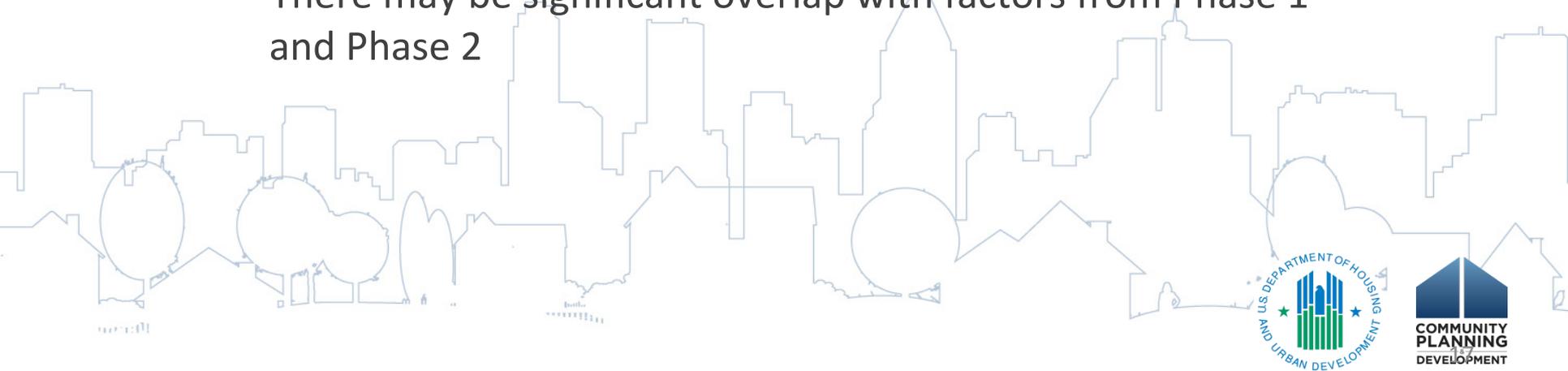
- If multiple components or phases, provide a separate analysis and description for each component or phase
- Each component or phase should independently provide benefit or utility

Results	Kilchis River Crossings	Wilson River Intertie	Total Project
Benefits	\$900,621	\$4,204,988	\$5,105,609
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BCR	1.29	11.51	4.81



NDRC BCA Narrative Description

- Narrative shall identify evidence-based practices as the basis for the proposal
- HUD expects consistency between the BCA statement and the rest of the application
- Where information found elsewhere in application, provide the page number rather than restating here.
 - There may be significant overlap with factors from Phase 1 and Phase 2



NDRC BCA Narrative Description

	Eight Categories in BCA Narrative
1	Process for preparing the BCA.
2	Full proposal cost
3	Current situation and problem to be solved
4	Proposed project or program including estimated useful life
5	Risks to your community
6	List of all benefits and costs including rationale
	Risks to ongoing benefits from proposal
	Challenges to implementing the proposal



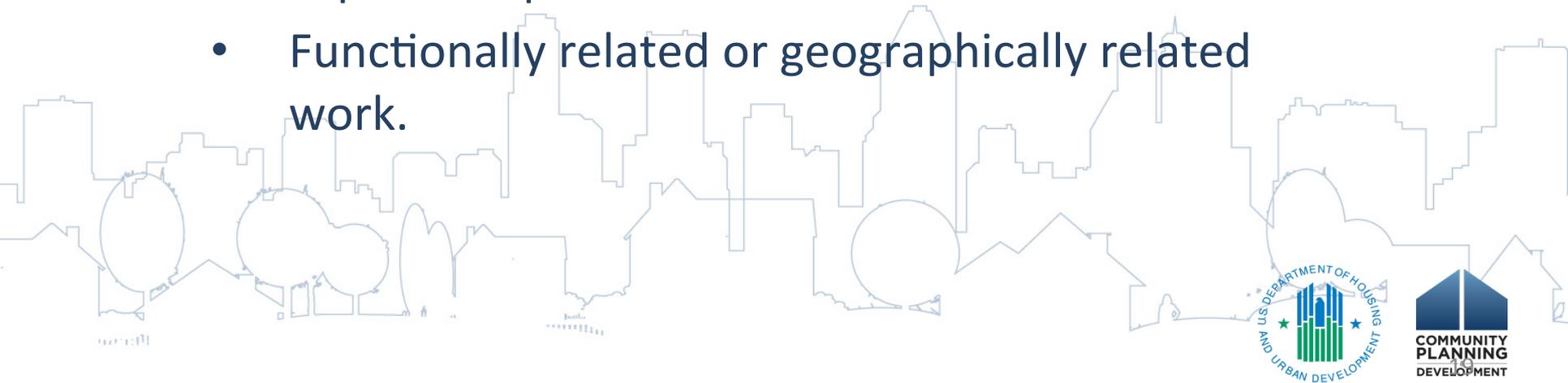
NDRC BCA Narrative Description

1. Describe the process for preparing the BCA

- Consultant or contractor prepared?
- How was applicant staff involved?

2. Full proposal cost

- Federal, state, local and private funding
- Expected operation and maintenance costs
- Functionally related or geographically related work.



NDRC BCA Narrative Description

3. Description of the current situation and the problem to be solved

- Critical, unique information
 - Quantified, relevant impacts of the qualifying disaster
 - Existing flood, wind, fire, earthquake, climate change or other risk in area?
 - Existing social conditions/challenges. What specific populations are vulnerable?
- Environmental conditions
 - Air and water quality
 - Land-use patterns and habitats
 - Environmentally sensitive areas
- How do trends in land use, housing development, affordability and employment affect disaster recovery or risks outlined above?



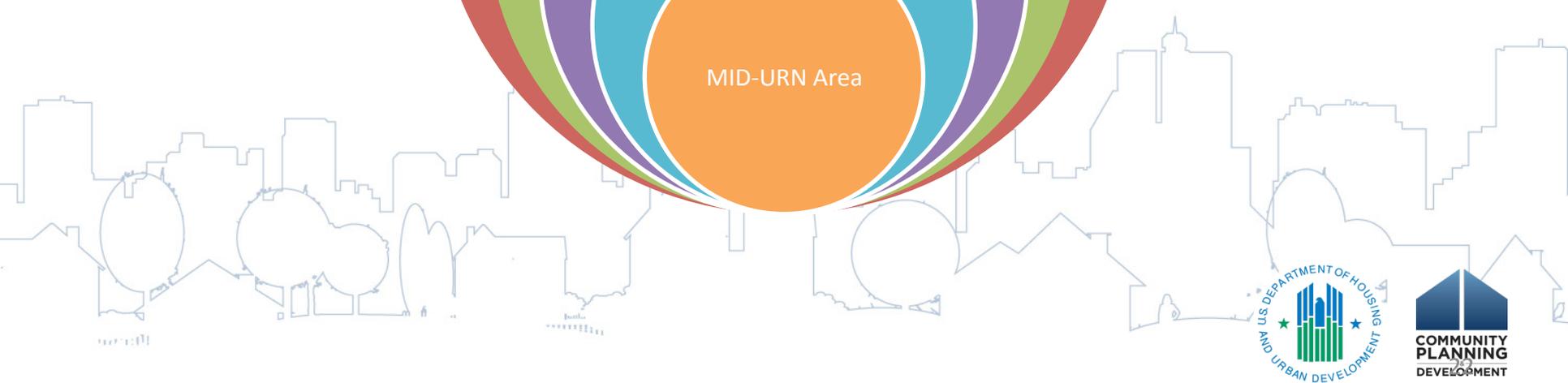
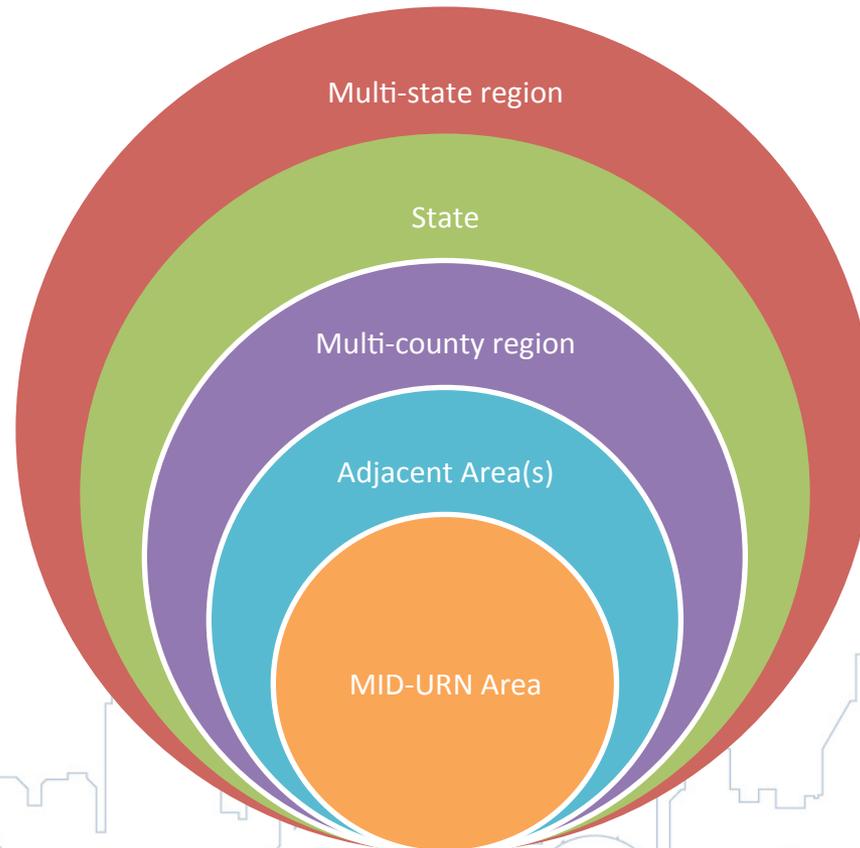
NDRC BCA Narrative Description

4. Description of the proposed project or program including functionally or geographically related elements and estimated useful life

- Key proposal objectives. Must group and evaluate together all individual activities related geographically, functionally, or logically
- Design philosophy
- Geographic boundaries and/or service area
- Main components of the proposal and their interaction
- Describe any anticipated changes to local policies
- Timeline for completion of full project and each component?
- Estimated useful life of the proposal
- Alternative discount rates and justification



Defining BCA Boundaries



NDRC BCA Narrative Description

5. Description of risk to your community if the proposal and any land use, zoning or building code changes are not implemented (cite data and sources)

- What would happen 5, 20 and 50 years from now? (full proposal and for each component)
- Impact on the community as a whole and vulnerable lower income populations
- If multiple components, are there additive benefits or impacts that will not be realized?
- Areas of concentrated poverty that will remain adversely affected by qualifying disaster
- Estimate costs avoided if similar disaster struck again accounting for how development may proceed differently if proposal is implemented



NDRC BCA Narrative Description

6. A list of the benefits and costs of the proposal and the rationale for including each effect using the table provided

a) Lifecycle Costs

b) Resilience Value

c) Environmental Value

d) Social Value

e) Economic Revitalization



NDRC BCA Narrative Description

a) Lifecycle Costs

- Project/investment costs. Estimated costs of environmental remediation, if applicable
- Operations and maintenance
- Any costs associated with actions taken by the applicant or any government partner to enhance resilience since the qualifying disaster as described in Attachment K



NDRC BCA Narrative Description

- b) Resilience Value: value of protection from future/ repeat disasters such as:
- Reduction of expected property damages due to future/repeat disasters
 - Reduction of expected casualties from future/repeat disasters
 - Value of reduced displacement caused by future/ repeat disasters
 - Reduced vulnerability of energy and water infrastructure to large-scale outages



NDRC BCA Narrative Description

c) Environmental Value

- Ecosystem and bio diversity effects
- Reduced energy use
- Noise levels
- Climate change-reduced greenhouse gas emissions
- Air quality—reduced criteria pollutants under the Clean Air Act
- Water quality
- Reduced urban heat-island effect



NDRC BCA Narrative Description

d) Social Value that would further community development objectives

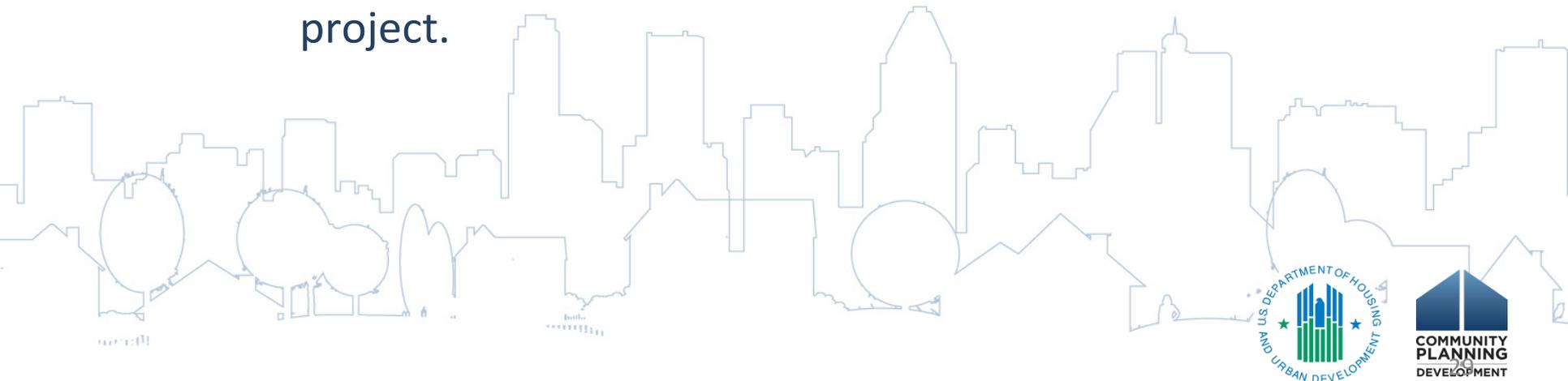
- Reductions in human suffering (lives lost, illness from exposure to contamination)
- Benefit to low and moderate-income persons and/or households
- Improved living environment
 - Elimination of slum and blight
 - Improved community identity and social cohesion
 - Improved recreational value
 - Access to cultural, historic, archaeological sites
 - Equal access to resilient community assets
- Greater housing affordability



NDRC BCA Narrative Description

e) Economic Revitalization

- Direct effects on local or regional economy net opportunity costs (e.g. tourism revenue)
- Value of property other than through enhanced flood protection, independent of increases in property value captured by other benefits in the BCA or that might otherwise have occurred without the proposed project.



Required Narrative Table

1	2	3	4	5	6	
Costs and Benefits by category Life cycle costs One row for each effect Name Resiliency Value One row for each effect Environmental Value One row for each effect Community Development Value One row for each effect Economic Revitalization One row for each effect	Page # in Factor Narratives or Attachment B C A	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable)	Uncertainty	
				\$		
					\$	
					\$	
					\$	
					\$	



Example Project from NOFA

- Voluntary flood buyouts in a low-lying area prone to flooding
- Qualifying flood had 4 foot flood depth and future floods are predicted in the same range.
- Applicant will use CDBG-NDR funds inside the most impacted and distressed target area and leverage funds in the larger surrounding area.
- The plan is to convert properties to open space including 100,000 square feet of riparian habitat.



Required Narrative Table

1	2	3	4	5	6
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable)	Uncertainty
Life cycle costs					
Buy-out in most impacted and distressed	Page 2 in Factor Narrative ; page 2 in BCA narrative	Applicant will use \$10 million CDBG-NDR funds to buy flood-prone homes along the Peach River in the Peach Pit neighborhood. Buyouts and demolition will occur over a 2 year period.	Funds available to purchase approximately 100 homes.	\$10,000,000 over 2 years	1
Buy-out in surrounding area	Page 3 in Phase 2 Factor 2; page 2 in BCA narrative	Applicant will use \$10 million in leveraged funds to buy flood-prone homes in the Apple Cart and Fire Pit neighborhoods. Buyouts and demolition will occur over a 2 year period.	Funds available to purchase approximately 100 homes.	\$10,000,000 over 2 years	1
Resilience Value					
Households	Page 3 in Phase 2 Factor 2; page 4 in BCA narrative	Project will permanently remove 200 homes from harms way. This will save disruption, repair and displacement costs.	FEMA displacement costs= (disruption cost x sf) + (rental costs x sf x time) x 200 homes. Homes average 1200 sf (county assessor) 4 ft flood event = 12 month recovery time (FEMA BCAR Table 3)	\$ 2,313,600 per disaster. 3 floods predicted over 50 years (see analysis)	4
Environmental Value					
Newly created riparian area	Page 4 in BCA narrative	Project will create 100,000 square feet of deed-restricted riparian open space along the Peach River between Apple Pier and Fire Spit. Riparian area will be created after 2 year buyout period.	Using FEMA's 2013 guidance on consideration of environmental benefits, we apply a value of \$12.29 per square foot of open riparian space per year.	\$1,290,000 per year. Starting in year 3 lasting through year	3

Required Narrative Table

1	2	3	4	5	6
Costs and Benefits by category	Page # in Factor Narratives or BCA Attachment	Qualitative Description of Effect and Rationale for Including in BCA	Quantitative assessment (Explain basis and/or methodology for calculating Monetized Effect, including data sources, if applicable)	Monetized effect (if applicable)	Uncertainty
Environmental Value					
Newly created riparian area	Page 4 in BCA narrative	Project will create 100,000 square feet of deed-restricted riparian open space along the Peach River between Apple Pier and Fire Spit.	Using FEMA's 2013 guidance on consideration of environmental benefits, we apply a value of \$12.29 per square foot of open riparian space per year.	\$1,290,000 per year. Starting in year 3 and lasting through year 50	3
Community Development					
Improved Social Cohesion	Page 5 in BCA narrative and page 2 in qualitative supplement	There is a link between social cohesion and resilience (Susan Cutter, et al.). Peach Pitt ranks high on the Social Vulnerability Index. Clearing blighted homes and moving residents into a safer neighborhood together will increase social cohesion.	We expect more frequent neighbor interactions and improved score on the Social Vulnerability Index. Based on our review of the literature (cite sources) we expect a strong positive impact ++	\$	5
Recreation	Page 4 in Phase 2 Factor 2, Page 3 in BCA Narrative	New riparian open space will create recreational opportunities such as fishing and bird watching	This benefit is included in the FEMA \$12.29 per square foot benefit of open riparian space	See newly created riparian area	3
Economic Revitalization					
Reduced insurance costs for businesses	Page 5 in BCA narrative	The 10 businesses along Peach Pitt road will have reduced flood insurance costs due to decreased flood risk	Commercial Flood insurance averages \$2000 per year for these 10 businesses (NFIP data and survey).	\$20,000 per year Start date depends on when FEMA issues letter of map amendment	3

SIMPLIFIED EXAMPLE

Required Narrative Table

Column 4: If no quantitative information is available, use the qualitative scale in Appendix H to score.

- Use expert judgments to score
- Scoring is relative to the description of the current situation and problem to be solved (narrative category 3)
- Provide a qualitative clarification for each score
- Identify required extra info needed for improving judgment

--	-	0	+	++	?
Strong negative	Negative	Neutral	Positive	Strong positive	unknown



NDRC BCA Narrative Description

7. Description of risks to ongoing benefits

- Key risks and uncertainties
- How effect positive and negative impacts
- Risks from climate change and costs of loss of function or service provided

8. An assessment of challenges faced with implementing the proposal.

- Political or stakeholder risks to implementation
- Technical risks
- Procedural (legal) risks
- Can applicant show broad community support? Any political or stakeholder issues? Have environmental groups and low-income and minority (especially Native American) populations been included in planning and alternative development?



NDRC Benefit Cost Analysis

- HUD will not fund any Phase 2 activities for which the benefits to the applicant's community and to the United States as a whole are not demonstrated by the evidence submitted to justify the costs.
- HUD recognizes CBA difficult for community development objectives and will take that into account
- You may include up to three pages summarizing other benefits or costs that are difficult to quantify



NDRC Benefit Cost Analysis

- All data and calculations for benefits and costs in a single spreadsheet tab or table
- Benefits and costs estimated each year for duration of analysis period
 - Can include a residual value at the end of the analysis period and treat as an additional benefit discounted to the end of the analysis period. (recommend sensitivity analysis depending on uncertainty of residual value)
- Results must be presented in form of a net present value and benefit-to-cost ratio
- Results must be reproducible based only on the information provided



Simplified BCA Example

Parameters

Discount rate 7%, useful life 50 years, dollars in millions

DF is discount factor, ADF is annuity discount factor

Computation Table

Event	Time Period	Benefit Value	Cost Value	DF/ADF	PV Benefit	PV Cost
CDBG-NDR buyouts and demolition	Year 1 + 2		5	1.8		9
Leverage buyouts and demolition	Year 1+2		5	1.8		9
Riparian Area	Year 3-50	1,290		13.8 (1.8 year 1-2)	15.5	
Resilience Value property	6% annual chance of a flood	2.31 x 6%=.14		13.8 (1.8 year 1-2)	1.68	
Reduced Insurance	Year 3-50	0.020		13.8 (1.8 year 1-2)	0.24	
					17.42	18

Analysis Table

Benefit/Cost Ratio = 0.96

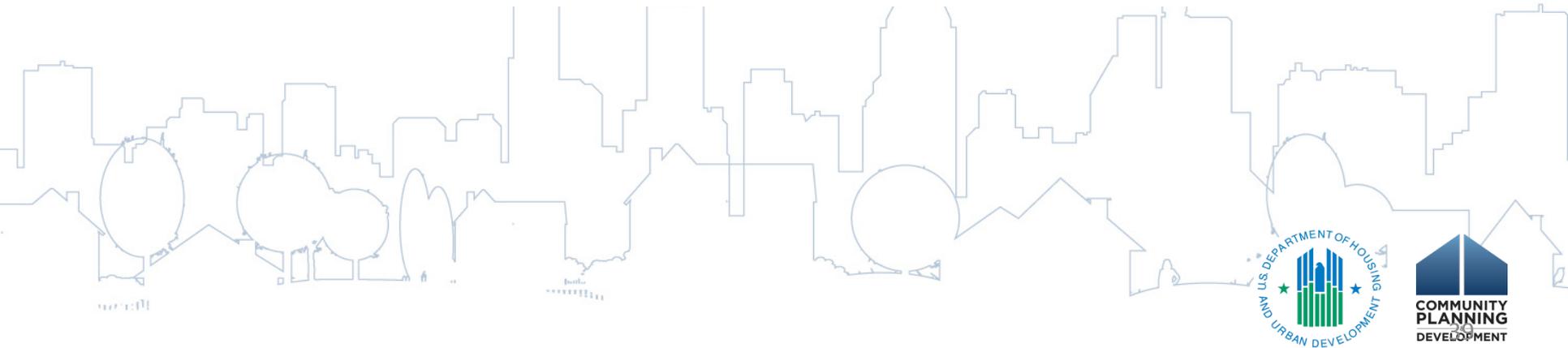
Net Present Value = - 0.58

This example is incomplete—there may be additional benefits and costs



Simplified BCA Example from DOT

Calendar Year	Project Year	Affected Drivers	Travel Time Saved (hours) ¹	Total Value of Time Saved (\$2013) ²	Initial Costs (\$2013)	Operations & Maintenance Costs (\$2013)	Undiscounted Net Benefits	Discounted at 7%
2015	1				\$38,500,000	\$6,000,000	-\$44,500,000	-\$41,588,785
2016	2	80,000	1,040,000	19,656,000		\$700,000	\$18,956,000	\$16,556,905
2017	3	95,000	1,235,000	23,341,500		\$700,000	\$22,641,500	\$18,482,208
2018	4	100,000	1,300,000	24,570,000		\$700,000	\$23,870,000	\$18,210,309
2019	5	102,000	1,326,000	25,061,400		\$700,000	\$24,361,400	\$17,369,342
2020	6	109,000	1,417,000	26,781,300		\$700,000	\$26,081,300	\$17,379,071
NPV								\$46,409,050
<ol style="list-style-type: none"> 1. Number of drivers times three minutes a day (3/60 hours) over 260 workdays 2. Hours at \$18.90 per hour for All Purpose inter-city travel (\$2013) 3. Includes costs from delays to users during construction 								



Data for BCA

Sources of data for your BCA include:

- Your Phase 1 and Phase 2 Factor Narrative (Especially Phase 2 Factor 2: Need/Extent of the Problem)
 - Information for narrative description; estimated useful life of the project; costs, benefits, and risks
- Appendix H lists basic assumptions for the analysis
- Federal, state, local, academic and non-profit sources

Upcoming webinar will go over data sources in more detail.



NDRC Basic Assumptions for BCA

- **Analysis Period:** Useful life of the proposal
- **Price Level:** 2015 constant prices
- **Inflation:** no general price inflation
- **Discount Rate:** Base-case discount rate in OMB Circular A-94 (7%). Applicants may **also** use alternate discount rates (not less than 3%) provided they are adequately justified
- **Value of statistical life:** FEMA's estimates based on Federal Aviation Administrations 2008 ratings.



NDRC Basic Assumptions for BCA

Value of statistical life published in the NOFA

Avoided Damages and Losses (cont.)

- The Federal Aviation Administration (FAA) rates the value of a person's injuries, from a minor injury to a fatality.
- The Willingness to Pay (WTP) values are based on four levels of severity.
- The 2008 FAA revised guidance is used in the BCA tool.
- FEMA will update these values periodically.

Injury Severity Levels	\$ WTP Value (rounded)
Dead – Fatal	\$5,800,000
Hospitalized	\$1,088,000
Treat and Release	\$90,000
Self Treat	\$12,000

Federal Aviation Administration, 2008. Revised Department Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis



NDRC Basic Assumptions for BCA

FEMA's current value of statistical life

Table 5: AIS Injury Severity Levels, Fraction of VSL, and Economic Values (2012 Dollars)

AIS Code	Description of Injury	Fraction of VSL	Economic Value
AIS 1	Minor	.0020	\$13,000
AIS 2	Moderate	.0155	\$102,000
AIS 3	Serious	.0575	\$379,000
AIS 4	Severe	.1875	\$1,237,000
AIS 5	Critical	.7625	\$5,032,000
AIS 6	Fatal	1.0000	\$6,600,000

Source for Fraction of VSL: FAA, 2008.



BCA Results

What happens if $BCR < 1$ or $NPV < 0$?

- Submit a thorough 3-page supplement summarizing benefits and costs that are difficult to quantify
- Revisit project definition, scope and assumptions
- Revisit project: evaluate alternatives that will increase benefits or decrease costs
- Revisiting the project meets HUD's goal of a competition structured iteratively to guide each applicant through broad consideration in Phase 1 to more detail in Phase 2



Intersection Points with Factor Narratives

Factor 2a: Unmet Recovery Need and Target Geography. The BCA must at minimum address all needs described in this section. HUD encourages applicants to consider additional benefits and costs.

Factor 2b: Resilience Needs within Recovery Needs may overlap with narrative for BCA.

Factor 5: Allows up to 10 points for long-term commitment. Covered projects will only get points if the BCA incorporates benefit and costs related to this factor



Other BCA Resources

OMB Circular A-94:

[Circular A-94](#)

OMB Circular A-4 (provides additional guidance on how to quantify and monetize Benefits and Costs):

[Circulars A-4](#)

[A-4 FAQ](#)

FEMA BCA resources:

[Benefit cost analysis](#)

[Fema 33295](#) (2013 Mitigation Policy on Env. Benefits)

DOT BCA Resources:

[DOT Guidance](#)

[DOT Outreach](#)

Social Vulnerability Index: [Social Vulnerability](#)

Submit NDRC questions to: resilientrecovery@hud.gov

NDRC NOFA And Resilience Webinar Series: [NDRC Webinar Series](#)

Questions?

resilientrecovery@hud.gov

