

Climate Change Impacts and Adaptations at Maryland State Parks

January 2022

Prepared by:

University of Maryland School of Architecture, Planning & Preservation

Faculty:

Michael Ezban, Clinical Assistant Professor
Jana VanderGoot, Associate Professor

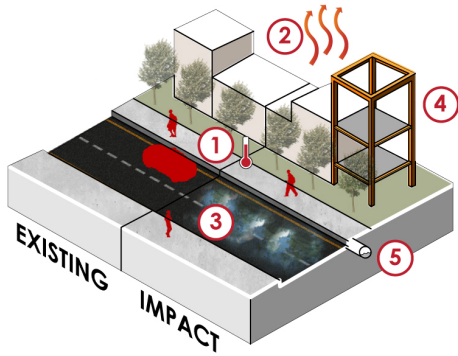
Students:

Samantha Jamero
Jihee Lee
Ethan Ratliff



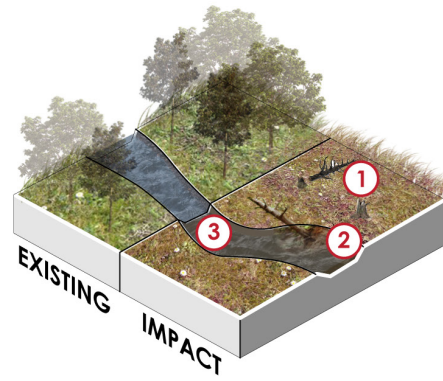
This report was prepared by faculty and students at the University of Maryland School of Architecture, Planning & Preservation, using Federal funds under award number NA19NOS4190162 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

CLIMATE CHANGE IMPACTS IN MULTIPLE ENVIRONMENTS



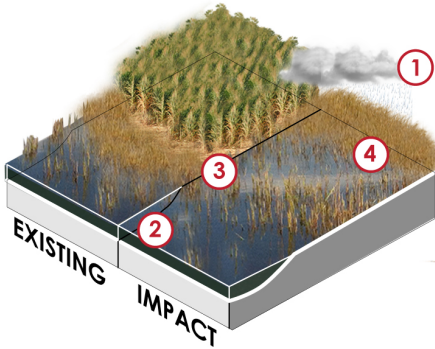
URBAN

1. TEMPERATURE RISE
2. INCREASED CARBON DIOXIDE
3. INCREASED FLOODING
4. DAMAGED BUILDING
5. GRAY WATER SURFACING



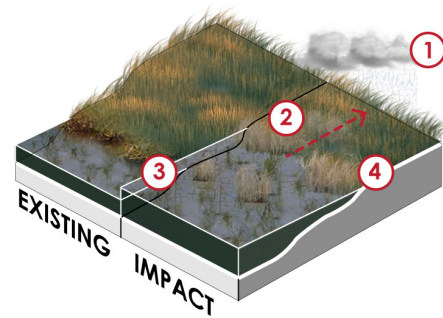
FOREST STREAM

1. TREE LOSS
2. EROSION
3. DEGRADED WATER QUALITY



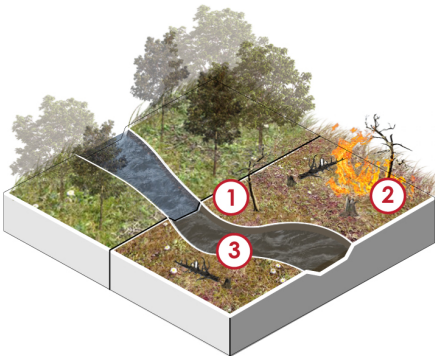
COASTAL AGRICULTURE

1. INCREASED PRECIPITATION
2. SEA LEVEL RISE
3. INCREASED NUTRIENT RUNOFF
4. SALT INUNDATION



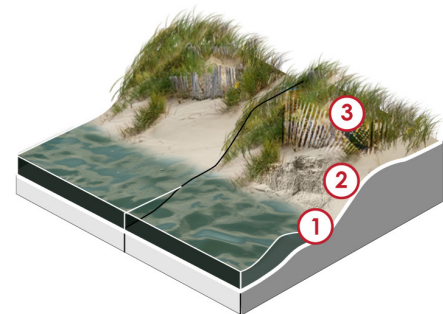
COASTAL MARSH

1. INCREASED PRECIPITATION
2. MARSH MIGRATION
3. INUNDATED MARSHES
4. PHRAGMITES



FOREST

1. DEAD TREES
2. FOREST FIRES
2. INVASIVE SPECIES



BEACH COAST

1. SEA LEVEL RISE
2. DUNE EROSION
3. BROKEN SAND FENCES

SUMMARY OF CLIMATE CHANGE IMPACTS AND ADAPTATIONS

URBAN

IMPACTS



TEMPERATURE RISE



FLOODING



DAMAGED BUILDINGS

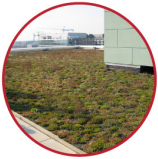


INCREASED CO₂

ADAPTATIONS



RAIN GARDENS



GREEN ROOF



PERMEABLE PAVING



SHADING DEVICES

FOREST STREAM

IMPACTS



TREE LOSS



EROSION

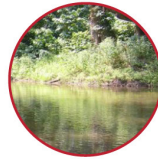


DEGRADED WATER QUALITY

ADAPTATIONS



BEAVER DAM ANALOGS



LIVE STAKES



FLOOD PLAIN CONNECTION



STEP POOLS

COASTAL AGRICULTURE

IMPACTS



INCREASED PRECIPITATION



SEA LEVEL RISE



MARSH MIGRATION



SALT INUNDATION

ADAPTATIONS



SHIFT AGRICULTURE



REMOVE AGRICULTURE



RESTORATION/ VEGETATED BUFFERS

COASTAL MARSH

IMPACTS



INCREASED PRECIPITATION



MARSH MIGRATION



INUNDATED MARSHES



PHRAGMITES

ADAPTATIONS



THIN LAYER PLACEMENT



RUNNELS



LIVING SHORELINE



MARSH SILL

FOREST

IMPACTS



SPECIES LOSS



HABITAT LOSS



INVASIVE SPECIES



CHANGE IN CARBON SEQUESTRATION

ADAPTATIONS



REMOVAL OF INVASIVE SPECIES



CLIMATE TOLERANT VEGETATION



CARBON SEQUESTERING WETLANDS

BEACH COAST

IMPACTS



SEA LEVEL RISE



DUNE EROSION



BROKEN SAND FENCES



DAMAGED BUILDINGS

ADAPTATIONS



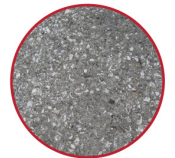
BEACH NOURISHMENT



PLANTING FOR EROSION CONTROL



ELEVATE BUILDINGS 4'-0"



PERMEABLE PAVING

CHANGING PRECIPITATION PATTERNS AND INCREASING STORM FREQUENCY

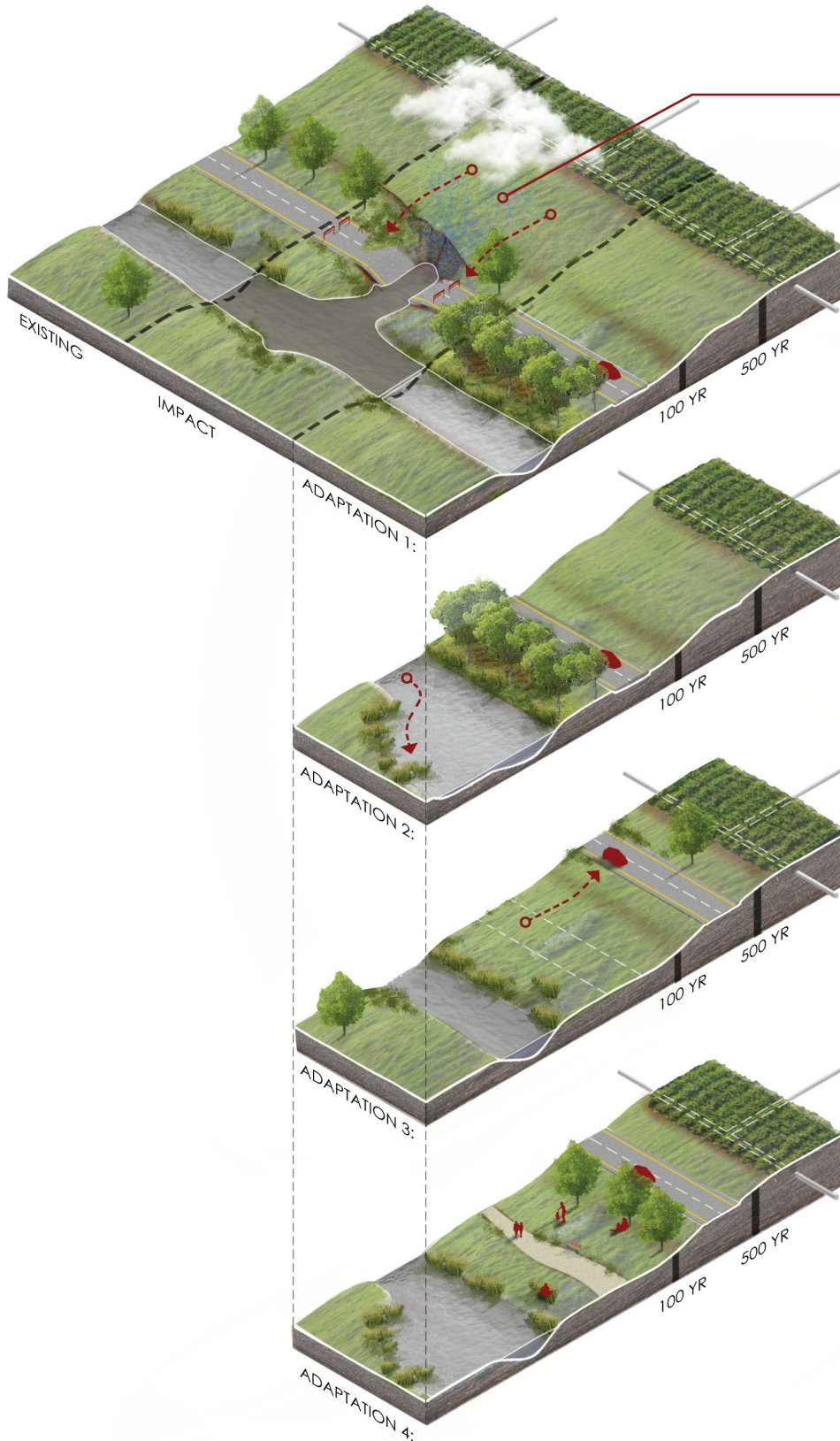
CLIMATE CHANGE IMPACTS AND ADAPTATIONS



RUNOFF



FLOODING/EROSION ROAD COLLAPSE



RIPARIAN BUFFER

VEGETATED BUFFER THAT BUFFERS THE IMPACT OF WATER ON THE LAND



WETLAND EXPANSION

ADJACENT WETLAND STRUCTURE ALLOWS FOR ADDITIONAL WATER OVERFLOW



RELOCATE ROADS

RELOCATE ROADS TO HIGHER ELEVATIONS TO AVOID FLOODING



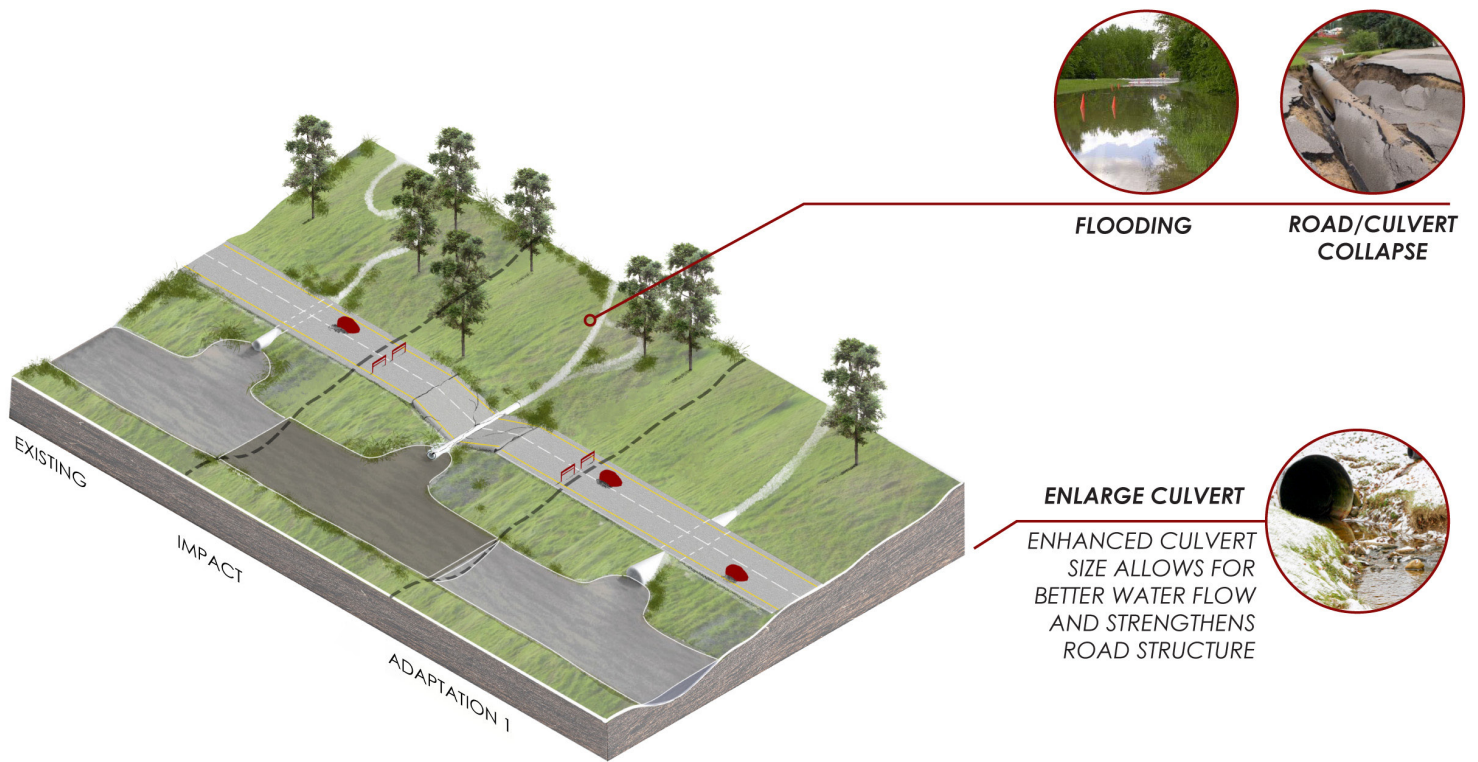
FLOODPLAIN PARK

A PARK THAT CAN ALLOW FOR FLOODING IN LOW-LYING AREAS



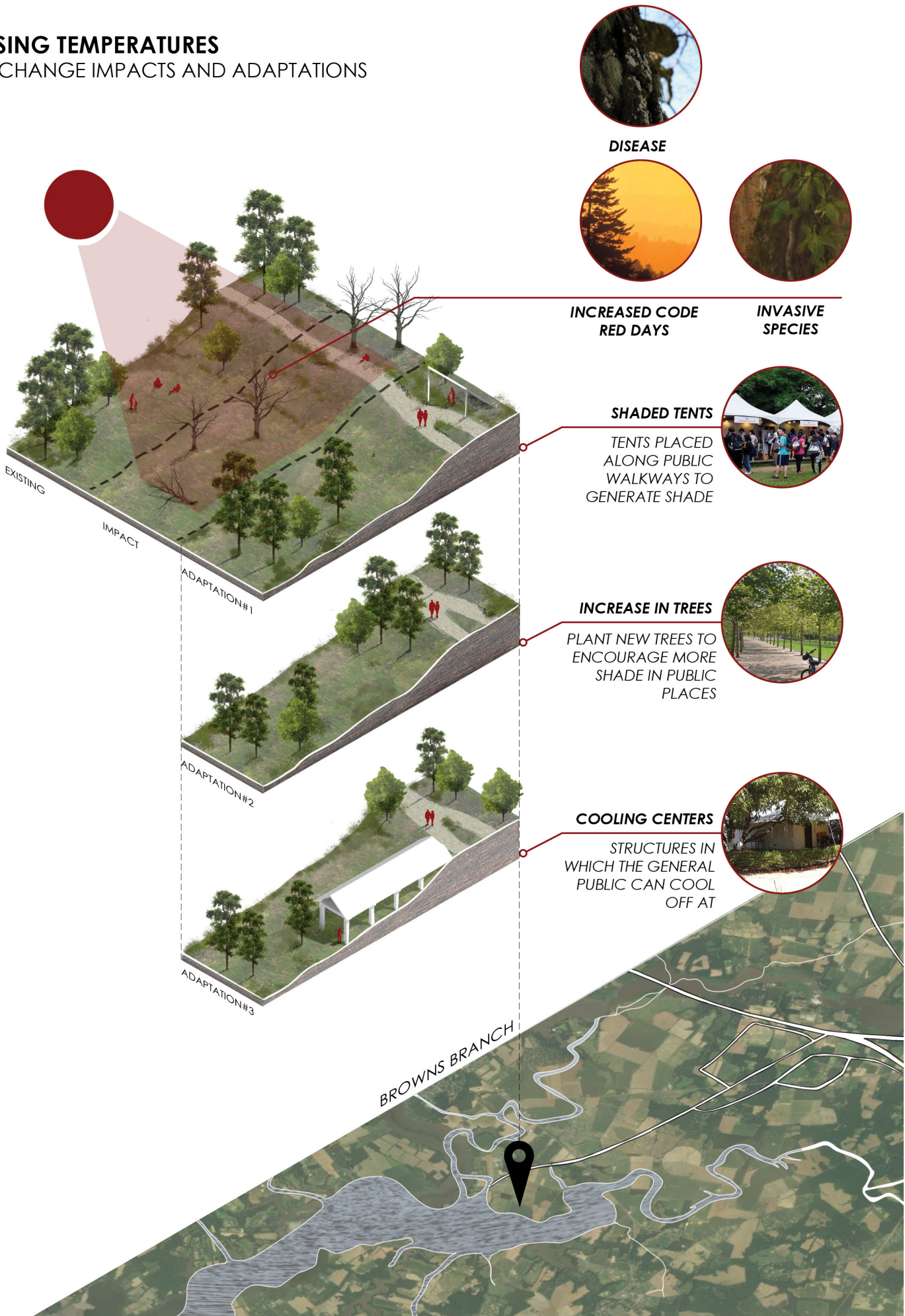
STORM IMPACTS TO ROADWAYS

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



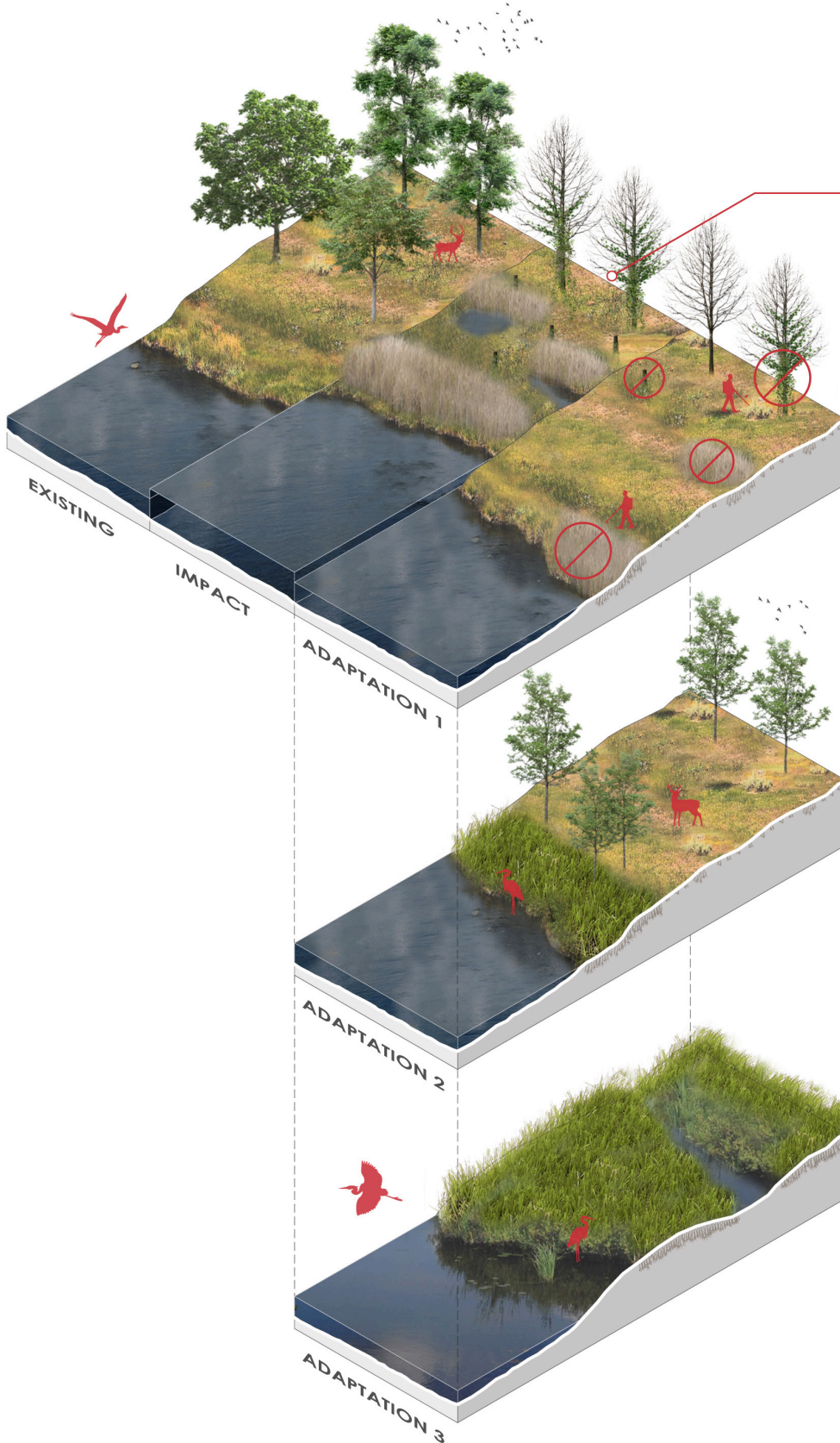
INCREASING TEMPERATURES

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



DECLINE IN BIODIVERSITY

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



SPECIES LOSS



HABITAT LOSS



INVASIVE SPECIES



CHANGE IN
CARBON
SEQUESTRATION

REMOVAL

REMOVE INVASIVE SPECIES SUCH AS VINE AND PHRAGMITES



PLANT

PLANT NEW CLIMATE TOLERANT VEGETATION



POSSIBLE FUTURE TRANSITION (+50 YEARS)

INCREASE CARBON SEQUESTRATION THROUGH WETLAND RESTORATION TO ACCOUNT FOR DECLINE IN TREE SPECIES, ASSUMING TREE LOSS DUE TO INUNDATION



SEA LEVEL RISE: COASTAL MARSH

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



INCREASED PRECIPITATION



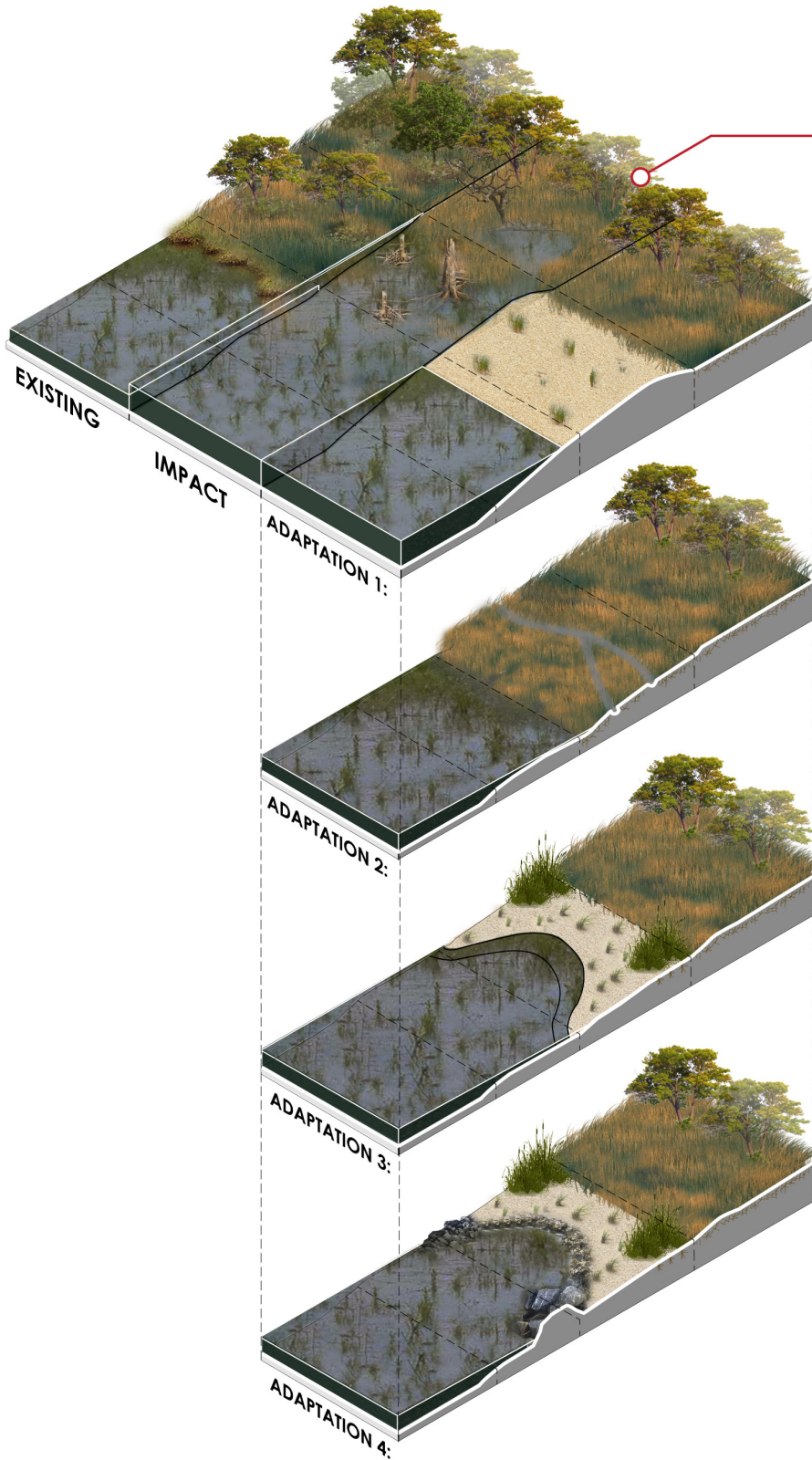
MARSH MIGRATION



INUNDATED MARSHES



PHRAGMITES



THIN LAYER PLACEMENT

THIN LAYERS OF SAND HELP TO BUILD UP THE COAST



RUNNELS

CANALS ARE CUT INTO SAND DEPOSITION



LIVING SHORELINE

LIVING SHORELINES CREATE A STABLE SCALLOPED SHAPED BEACH THAT ACCRETES SAND OVER TIME



MARSH SILL

ADDITION OF A HARDENED EDGE WILL HELP TO BUILD RESISTANCE TO EROSION



SEA LEVEL RISE: COASTAL AGRICULTURE

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



INCREASED
PRECIPITATION



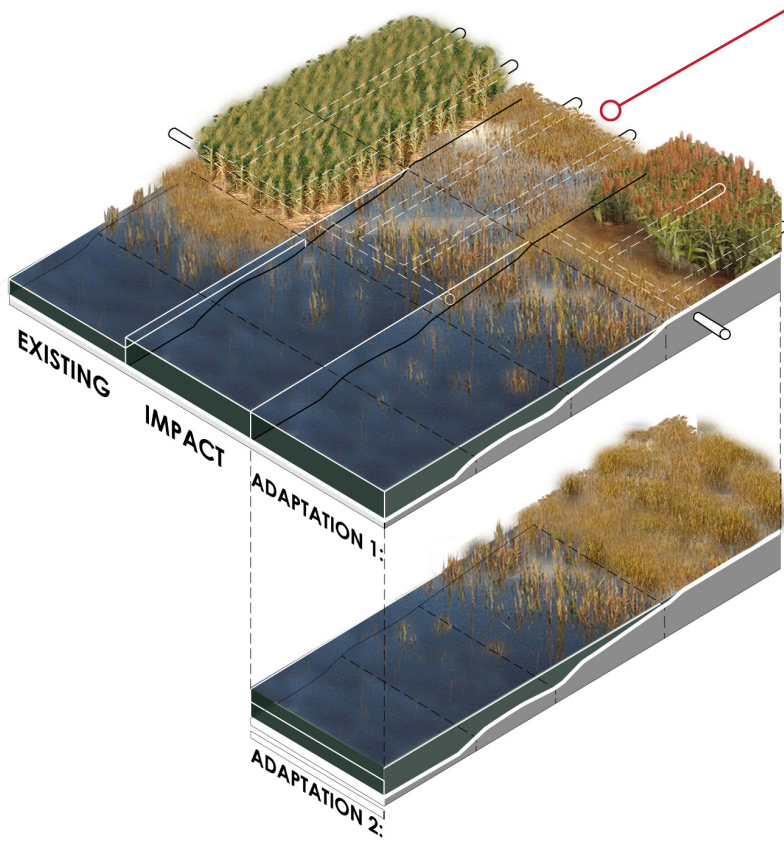
SEA LEVEL RISE



MARSH
MIGRATION



SALT
INUNDATION



SHIFT AGRICULTURE

SHIFT AGRICULTURE UPLAND
AND PLANT SALT TOLERANT SPECIES
i.e. SORGHUM



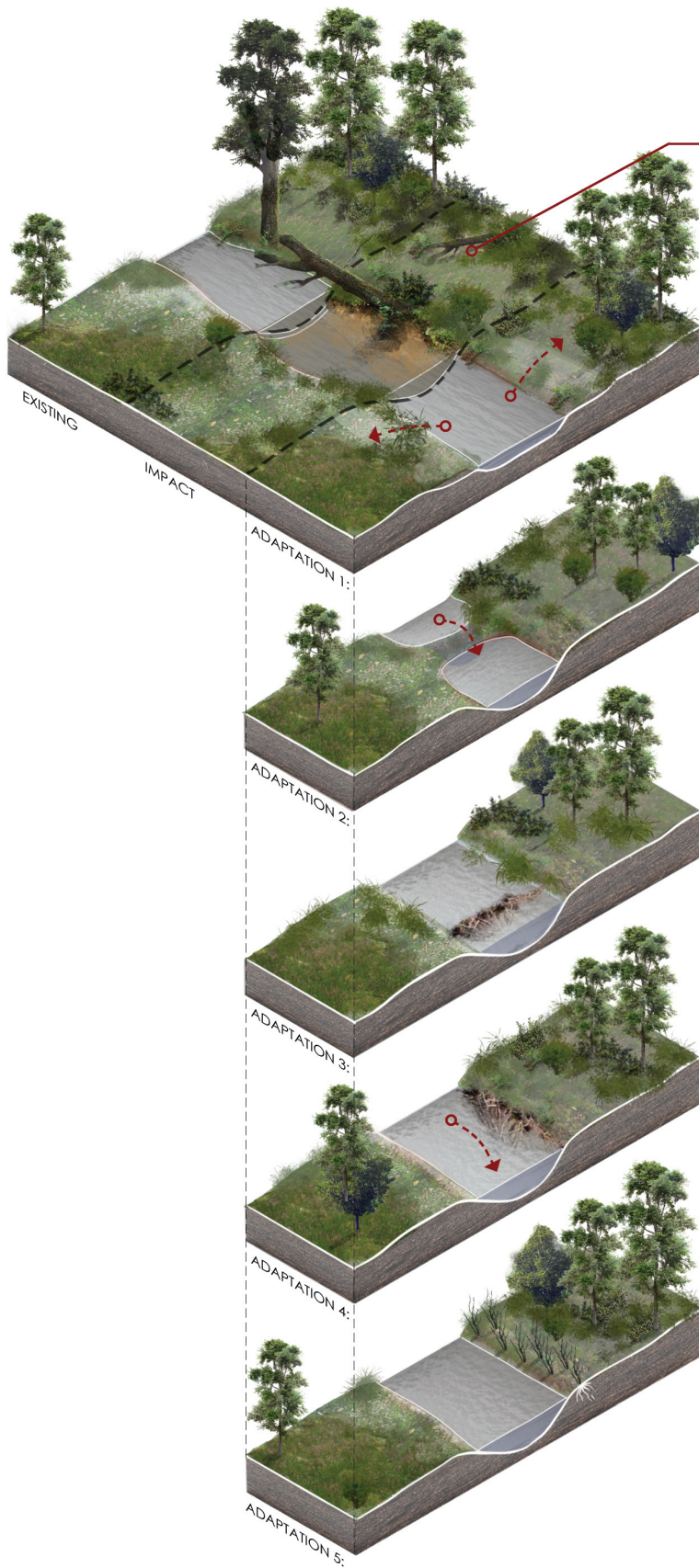
REMOVE AGRICULTURE

REMOVE AGRICULTURE AND
CONVERT TO MARSH HABITAT



FOREST STREAMS

CLIMATE CHANGE IMPACTS AND ADAPTATIONS



TREE LOSS



EROSION



DEGRADING WATER QUALITY

FLOODPLAIN CONNECTION

THE RIVER IS CONNECTED TO THE FLOODPLAIN TO ALLOW FOR FLOOD MANAGEMENT, TEMPERATURE CONTROL, AND INCREASED HABITAT



STEP POOLS

CHANNEL FORMS USED TO SLOW THE FLOW OF WATER



BEAVER DAM ANALOGS

CHANNEL SPANNING WOODEN STRUCTURES THAT SLOW WATER FLOW



TOE WOOD

ROOT WADS PLACED AT THE RIVERS EDGE TO REDIRECT WATER



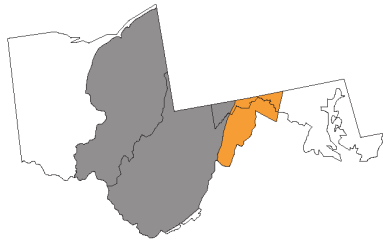
LIVE STAKES

LONG CUTTINGS DRIVEN INTO THE GROUND TO STRENGTHEN SOIL



PLANTING FOR ECOLOGICAL PROVINCES

* NOTE: TREE RECOMMENDATIONS MAY VARY BASED ON SPECIFIC MICROCLIMATES WITHIN REGION



**CENTRAL APPALACHIANS
WESTERN MARYLAND**

CLIMATE CHANGE TOLERANT TREE SPECIES

NEW TO THIS HABITAT, AND WITH MIGRATION POTENTIAL



BLACKJACK OAK
QUERCUS MARILANDICA



CHERRYBARK OAK
QUERCUS FAGODA



FLORIDA MAPLE
ACER FLORIDANUM



PECAN
CARYA ILLINOINENSIS



POST OAK
QUERCUS STELLATA



SHUMARD OAK
QUERCUS SHUMARDII



SUGARBERRY
CELTIS LAEVIGATA



SWEETGUM
LIQUIDAMBAR STYRACIFLUA



WATER OAK
QUERCUS NIGRA



WILLOW OAK
QUERCUS PHELLOS

CLIMATE CHANGE TOLERANT TREE SPECIES

NEW TO THIS HABITAT



BLACK HICKORY
CARYA TEXANA



BLACKJACK OAK
QUERCUS MARILANDICA



LOBLOLLY PINE
PINUS TAEDA



POST OAK
QUERCUS STELLATA



SUGARBERRY
CELTIS LAEVIGATA



WINGED ELM
ULMUS ALATA

EXISTING AND LIKELY TO INCREASE



BEAR OAK: SCRUB OAK
QUERCUS ILICIFOLIA



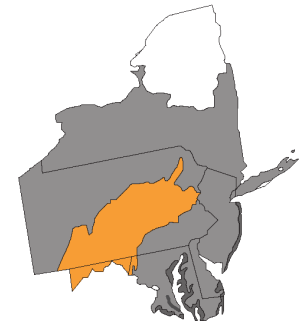
BLACK WALNUT
JUGLANS NIGRA



FLOWERING DOGWOOD
CORNUS FLORIDA



SHORTLEAF PINE
PINUS ECHINATA



**RIDGE AND VALLEY
(SUBREGION 4)**

CLIMATE CHANGE TOLERANT TREE SPECIES

NEW TO THIS HABITAT



BLACKJACK OAK
QUERCUS MARILANDICA



SLASH PINE
PINUS ELLIOTTII



BEAR OAK: SCRUB OAK
QUERCUS ILICIFOLIA



HACKBERRY
CELTIS OCCIDENTALIS



BITTERNUT HICKORY
CARYA CORDIFORMIS



PIN OAK
QUERCUS PALUSTRIS



EASTERN RED CEDAR
JUNIPERUS VIRGINIANA



SWEETGUM
LIQUIDAMBAR STYRACIFLUA

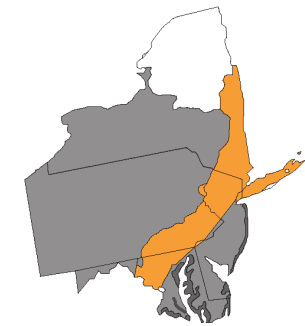


EASTERN REDBUD
CERTIS CANADENSIS



WHITE OAK
QUERCUS ALBA

EXISTING AND LIKELY TO INCREASE



**PIEDMONT
(SUBREGION 5)**

CLIMATE CHANGE TOLERANT TREE SPECIES

NEW TO THIS HABITAT



BLACK HICKORY
CARYA TEXANA



BLUEJACK OAK
QUERCUS INCIANA



CEDAR ELM
ULMUS CRASSIFOLIA



CHINKAPIN OAK
QUERCUS MUEHLENBERGII



HONEY LOCUST
GLEDITSIA TRIACANTHOS



LAUREL OAK
QUERCUS LAURIFOLIA



LONGLEAF PINE
PINUS PALUSTRIS



OSAGE-ORANGE
MACLURA POMIFERA

EXISTING AND LIKELY TO INCREASE



LOBLOLLY PINE
PINUS TAEDA



SOUTHERN RED OAK
QUERCUS FALCATA



**COASTAL PLAIN
(SUBREGION 6)**