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Prepared for
City of Edmonton

Prepared by
O2 Planning + Design



O2

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INTRODUCTION

The Land Management Classification for the Ribbon of Green project draws upon available spatial datasets, coupled with additional analysis and expert recommendations, to highlight important natural areas, and choose appropriate locations for recreational use and development. The entire study area is allocated into three Land Management Classifications:

- **PRESERVATION:** The intent of preservation areas is to protect the integrity of the natural environment and restore natural functioning with minimal disturbance to wildlife and vegetation; as a result, opportunities for people to access these areas will be limited.
- **CONSERVATION:** The intent of conservation areas is to introduce people to the natural environment of the River Valley and Ravine System, provide opportunities to enjoy this natural setting, and gain a greater appreciation for the system while minimizing environmental impact and restoring ecological functioning, when possible.
- **ACTIVE/WORKING LANDSCAPES:** Active/Working Landscapes are public spaces that provide opportunities for people to interact with each other and participate in a variety of recreational activities within a river valley and ravine setting. This classification also acknowledges existing uses, including urban services. Like the other two classifications, opportunities will be sought in this classification to restore and/or enhance natural functions.

To determine the Land Management Classifications, four different datasets were explored: landslide risks, wildlife connectivity, environmental sensitivity and historically important cultural areas. Additionally, existing land cover data, compiled during the BREATHE: Green Network Strategy, provided a finer-scale representation of existing conditions. A summary of this information was invaluable for distinguishing between existing non-natural human footprints, semi-natural cover, and the remaining relatively undisturbed natural vegetation.

Ecological Network Maps were created to identify the current conditions and highlight key components supporting the natural function of the landscape. Such maps included wetlands and open water, environmental sensitivity model outputs, natural land cover, unique and rare vegetation types, and important wildlife connectivity movement areas, which are all important factors to acknowledge when planning for this area. Notable connections between natural areas were also highlighted manually through expert review of the region.

DATASET OVERVIEW

The recommended Land Management Classification (Preservation, Conservation and Active Working Landscapes/Intensive Recreation) was informed initially by four major spatial datasets:

- **Landslide risks** were identified during the geotechnical assessment, drawing on LiDAR and aerial imagery to identify where slopes had previously been compromised.
- **Important Wildlife Movement Areas** were assessed using the Circuitscape model¹, drawing on land cover information to assess the difficulty in moving through the landscape, identifying pinch points where expected movement is most likely.
- **The City's Environmental Sensitivity Model** makes recommendations for the appropriate classifications, based on a 26 individual datasets.
- **Archaeological Potential**, drawing from expert recommendations, identifies known and likely locations of cultural and archaeological finds.

The combination of these four datasets resulted in an initial data-recommended spatial delineation of the Land Management Classifications, which through consultation with the City has been adapted and manually revised to create the proposed Land Management Classification Map. Modification to the data-recommended management classification was made to ensure that it aligned with the intended plans and existing conditions within the study area. Areas of recreational use (such as existing private golf courses), planned parks (such as Oleskiw River Valley Park), historic recreational use (such as the Old Klondike Campground) and areas with vehicle access (such Woodbend Natural Area) had some appropriate areas of the site shifted to Active Working Landscapes/Intensive Recreation with buffers of Conservation added to separate the more intensive use from Preservation areas.

¹ Circuitscape is a landscape connectivity analysis software package which uses information about the land cover of the area to predict the potential patterns of wildlife movement, identifying areas that are most likely to be used by wildlife as they move across the landscape.

STUDY AREA BOUNDARY

The study area boundary was initially based on the *North Saskatchewan River Valley and Ravine System Area Redevelopment Plan* boundary. The study area boundary was further refined with LiDAR-derived elevation models in order to more accurately reflect the top-of-bank. Further updates were then made manually, informed by slope, aerial imagery and existing Area Structure Plans for the surrounding area.



Figure 1. Original Study Area based on River Valley and Ravine Dataset

Using LiDAR datasets provided by the City of Edmonton, O2 developed a Digital Elevation Model (DEM) which identified slopes with 1m precision. Using this DEM, existing vegetation and aerial photography (with 25cm precision) from 2016, O2 refined the study area boundaries, which were subsequently approved by the City of Edmonton. The end result is a study-area boundary that more closely follows the top of bank, includes relevant ravines and gullies, and provides a more suitable starting point for the planning process.



Figure 2. Digital Elevation Model (DEM)

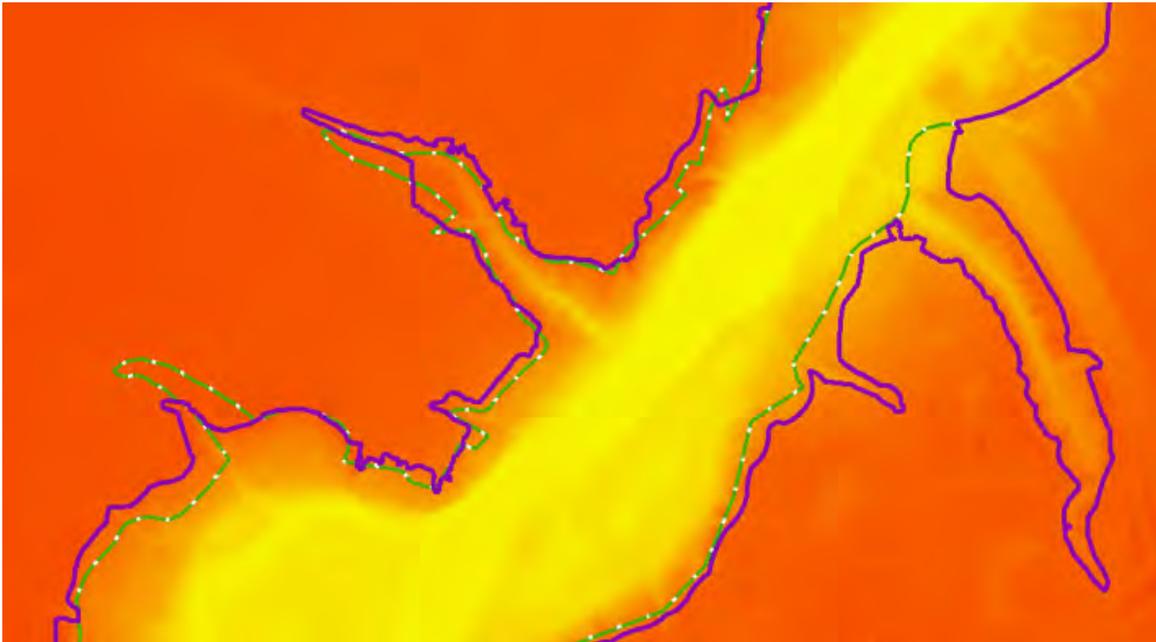


Figure 3. Study Area Boundary Comparison - Original (Green), Updated (Purple)

LANDSLIDE RISKS

The geotechnical analysis was done by Thurber Engineering Ltd. (Thurber). Bare earth LiDAR from 2015 was used to identify landslides along the valley slopes of the North Saskatchewan River Valley and its tributary ravines. Approximate locations of these landslide features are shown on Figure 6 and 7. At the active landslide locations, the river has actively eroded the toe of the slope, triggering slumping of the upper portions of the slope. Landslide risk analysis formed an important part of the initial Geotechnical assessment; this Geotechnical Evaluation will also be used to inform Ribbon of Green policy and design direction.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Landslide Risk

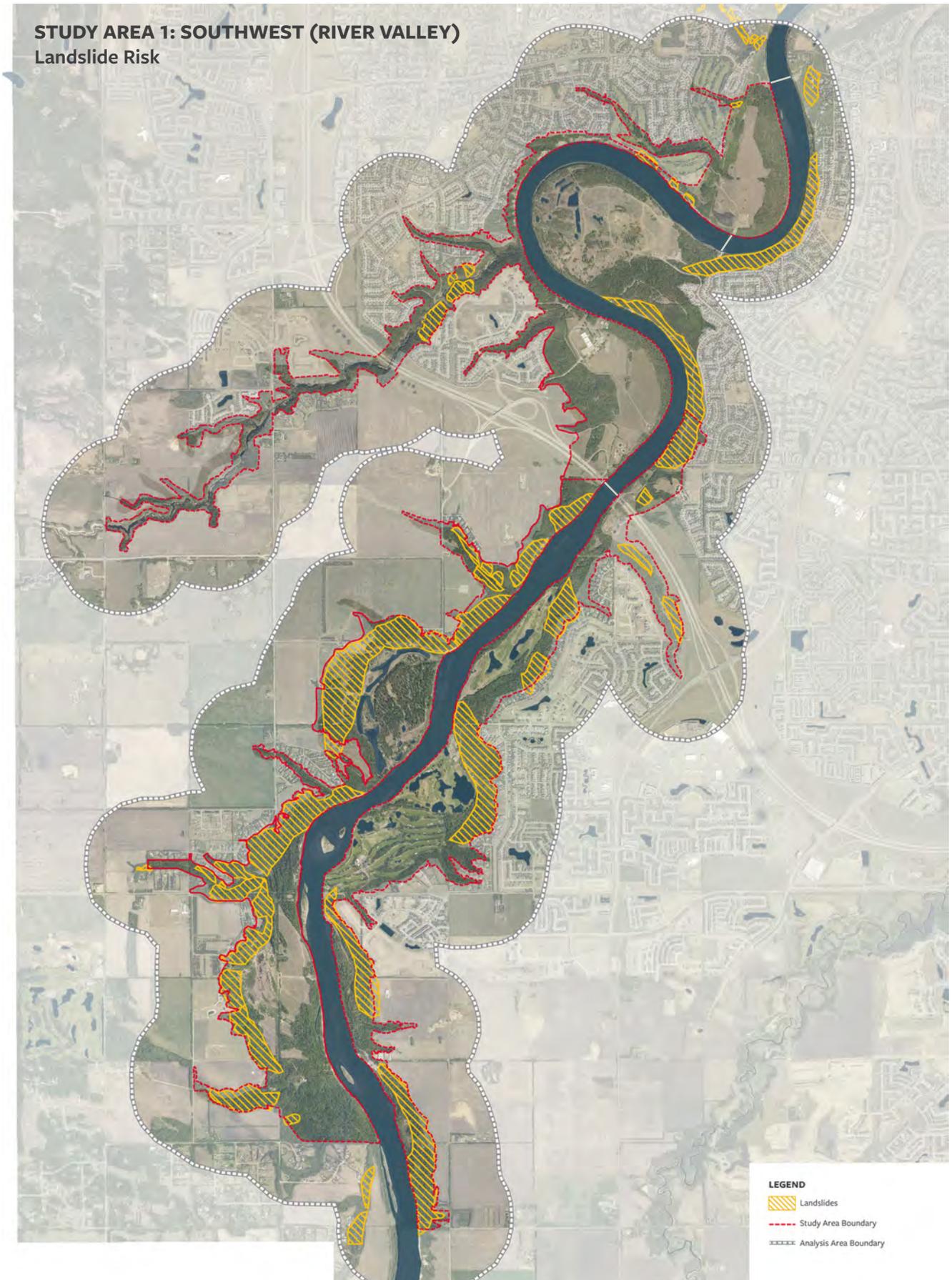


Figure 4. Southwest Landslide Areas (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Landslide Risk

- LEGEND**
-  Landslides
 -  Study Area Boundary
 -  Analysis Area Boundary

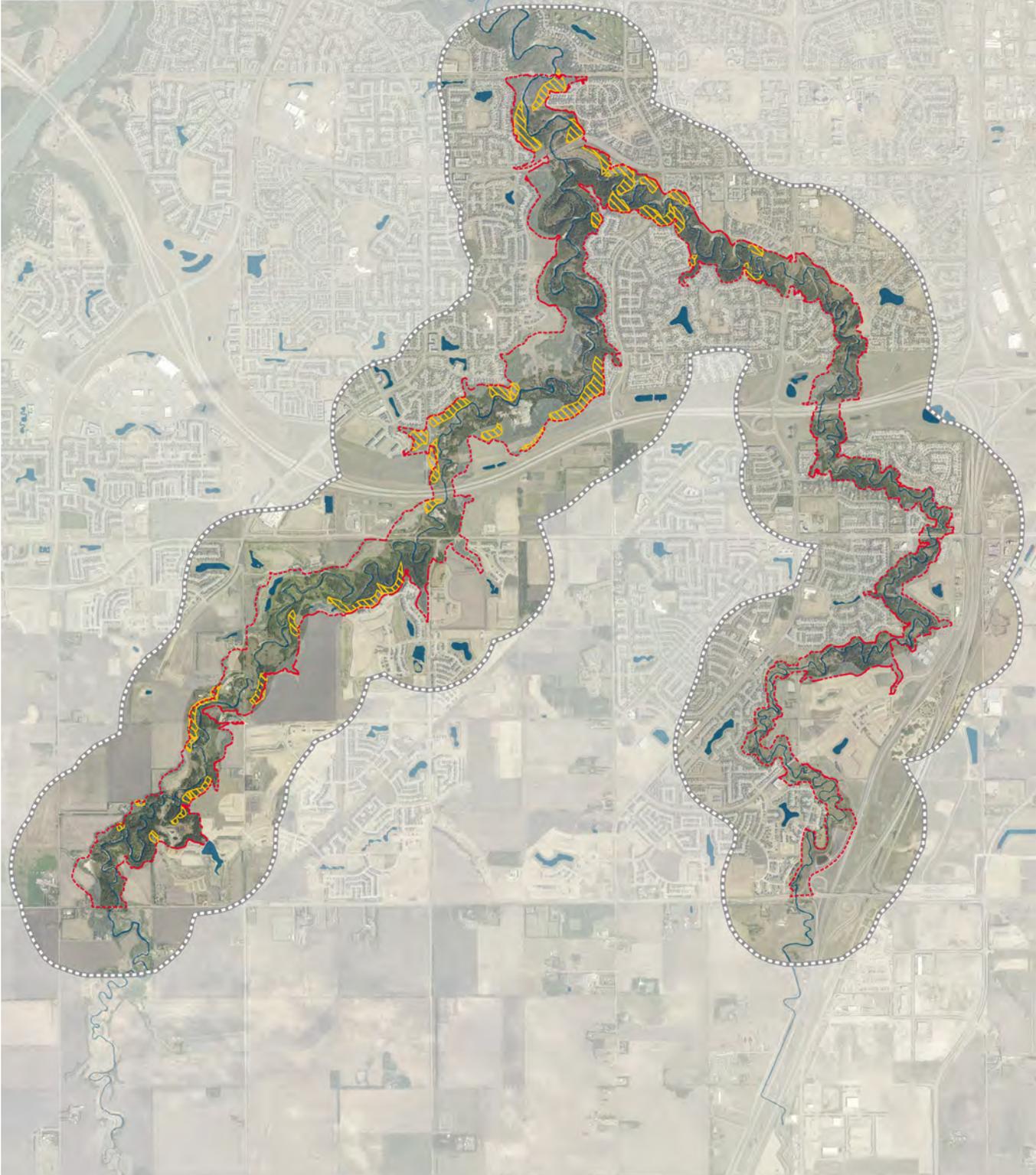
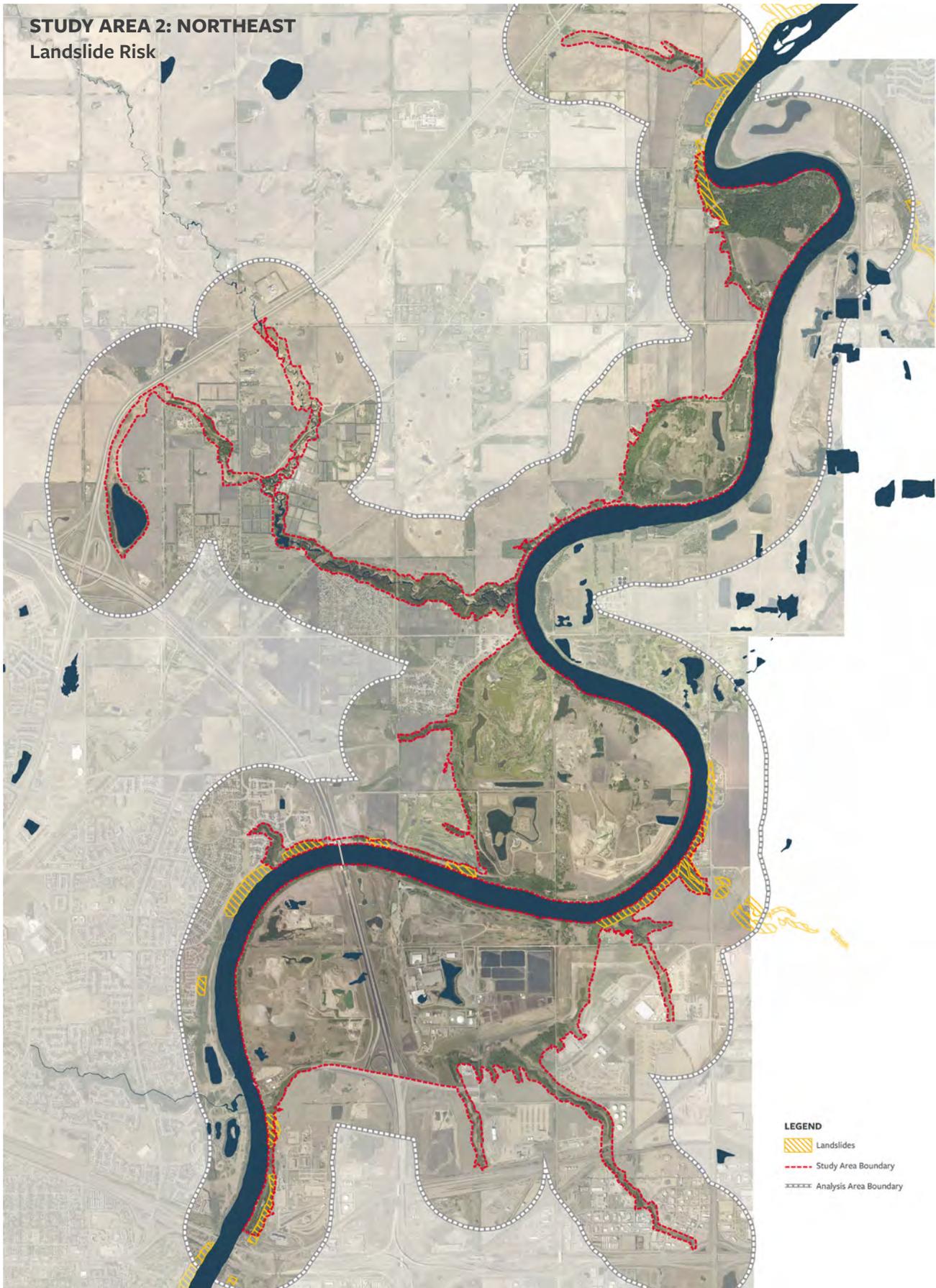


Figure 5. Southwest Landslide Areas (Ravine)

STUDY AREA 2: NORTHEAST
Landslide Risk



- LEGEND**
- Landslides
 - Study Area Boundary
 - Analysis Area Boundary

Figure 6. Northeast Landslide Areas

LAND COVER

The various surfaces which make up the landscape are referred to as 'land cover'. This cover may include water bodies, native vegetation, planted or otherwise non-native vegetation, and more impermeable constructed surfaces such as roads, parking lots and built structures. It is an essential layer which informs the broad understanding of the composition of the planning area, informing subsequent analysis of connectivity, and the recommended management classification. Land cover was compiled during the BREATHE analysis from datasets containing building footprints, sidewalks, paved and unpaved trails, roads, railways, hydrology, vegetation and developed areas. Discrete land cover classes were also categorized into natural, semi-natural, and non-natural subclasses, which were used for high-level mapping purposes.

NATURAL LAND COVER

Natural land cover includes areas with little to no regular human impact, minimal soil disturbance, and functioning natural processes. Natural land cover boundaries are typically irregular and may be unpredictably dispersed across the landscape, tending to be restricted to inaccessible areas.

Landscape features and land uses classified under the natural land cover category include:

- Natural water bodies
- Natural wetlands
- River channel
- River tributary
- Grasslands
- Poorly vegetated natural areas
- Shrubs
- Trees

SEMI-NATURAL LAND COVER

Semi-natural land cover is created through human disturbance, but tends to continue to facilitate natural functioning. Semi-natural land cover is permeable and has less impact on the hydrological functioning of the area. It is also accompanied by changes to the slope and terrain and typically features rectilinear boundaries. Landscape features and land uses classified under the semi-natural land cover category include:

- Artificial water bodies
- Cropland
- Pasture
- Unpaved trails
- Rural residential
- Disturbed land
- Maintained grass

NON-NATURAL LAND COVER

Non-natural land cover is human created and human-dominated. They are typically non-permeable and highly modified terrain. Light, noise and other disturbances are common. Landscape features and land uses classified under the non-natural land cover category include:

- Roads
- Building footprints
- Decorative elements
- Rail lines
- Fences
- Sidewalks
- Paved trails
- Urban residential
- Utility/industrial footprints
- Urban infrastructure
- Other forms of development (e.g. E.L. Smith Water Treatment Facility etc.)

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Land Cover

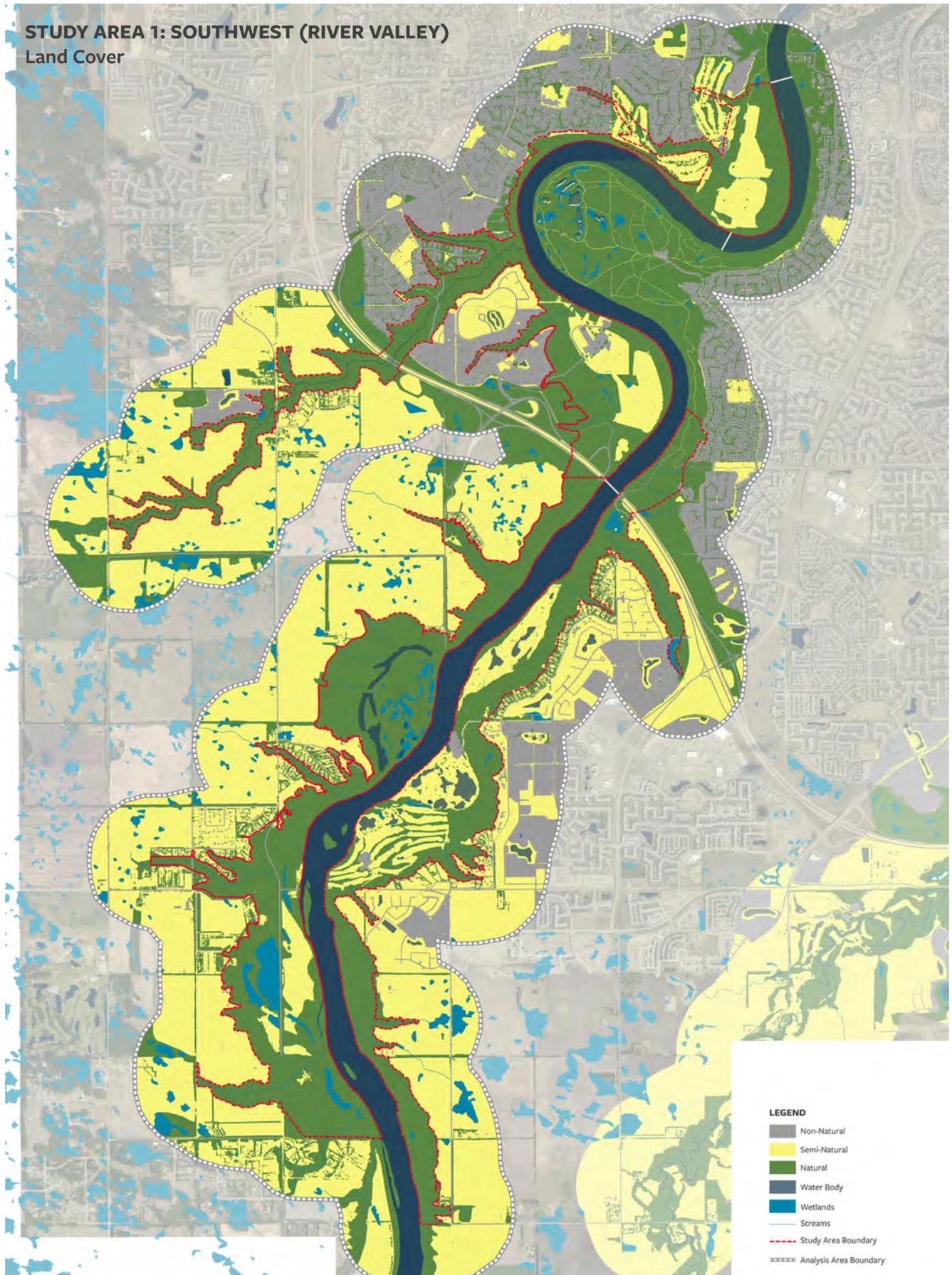


Figure 7. Southwest Study Area Land Cover (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Land Cover

- LEGEND**
- Non-Natural
 - Semi-Natural
 - Natural
 - Open Water
 - Wetlands
 - Streams
 - Study Area Boundary
 - Analysis Area Boundary

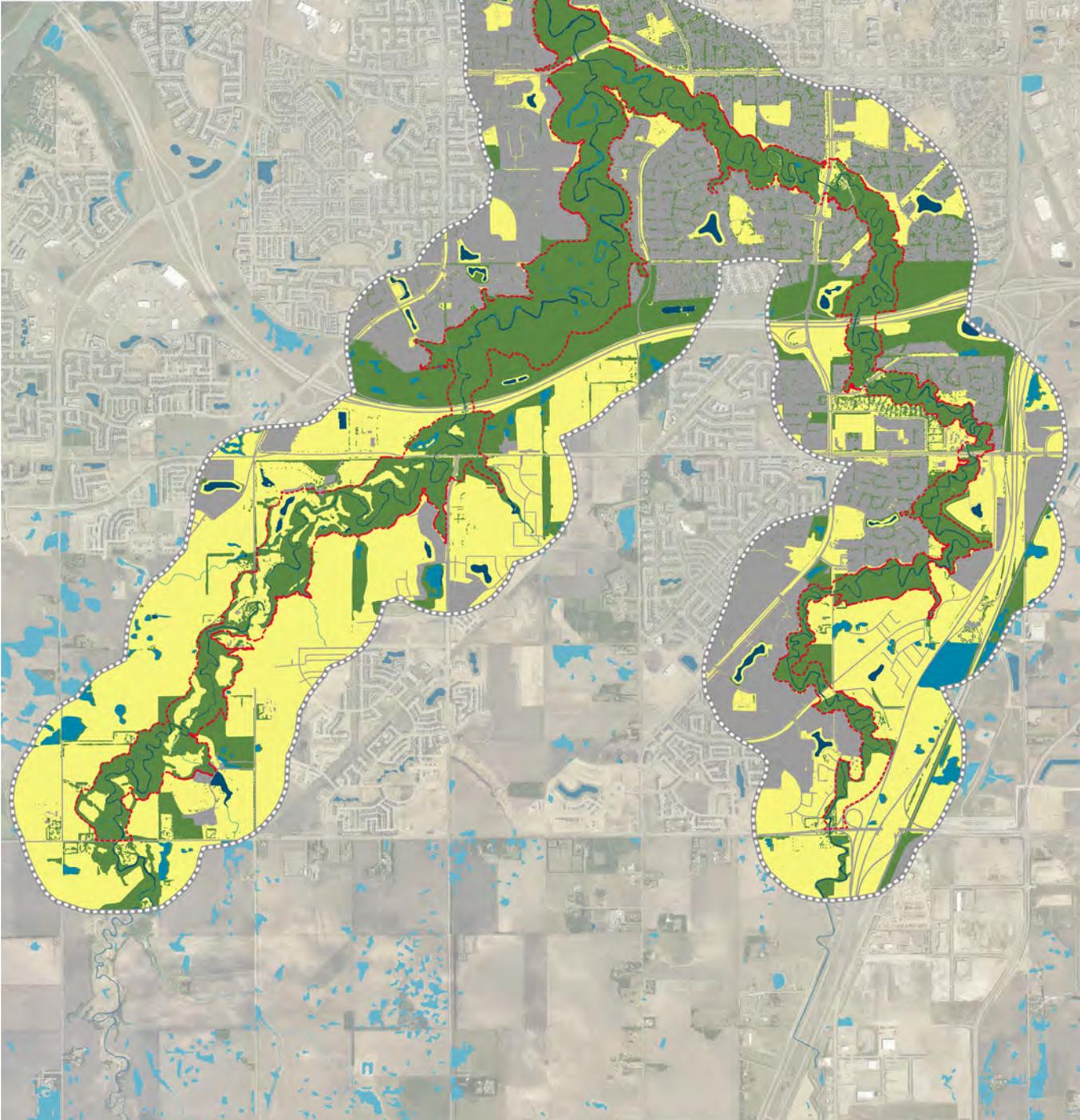


Figure 8. Southwest Study Area Land Cover (Ravine)

STUDY AREA 2: NORTHEAST
Land Cover

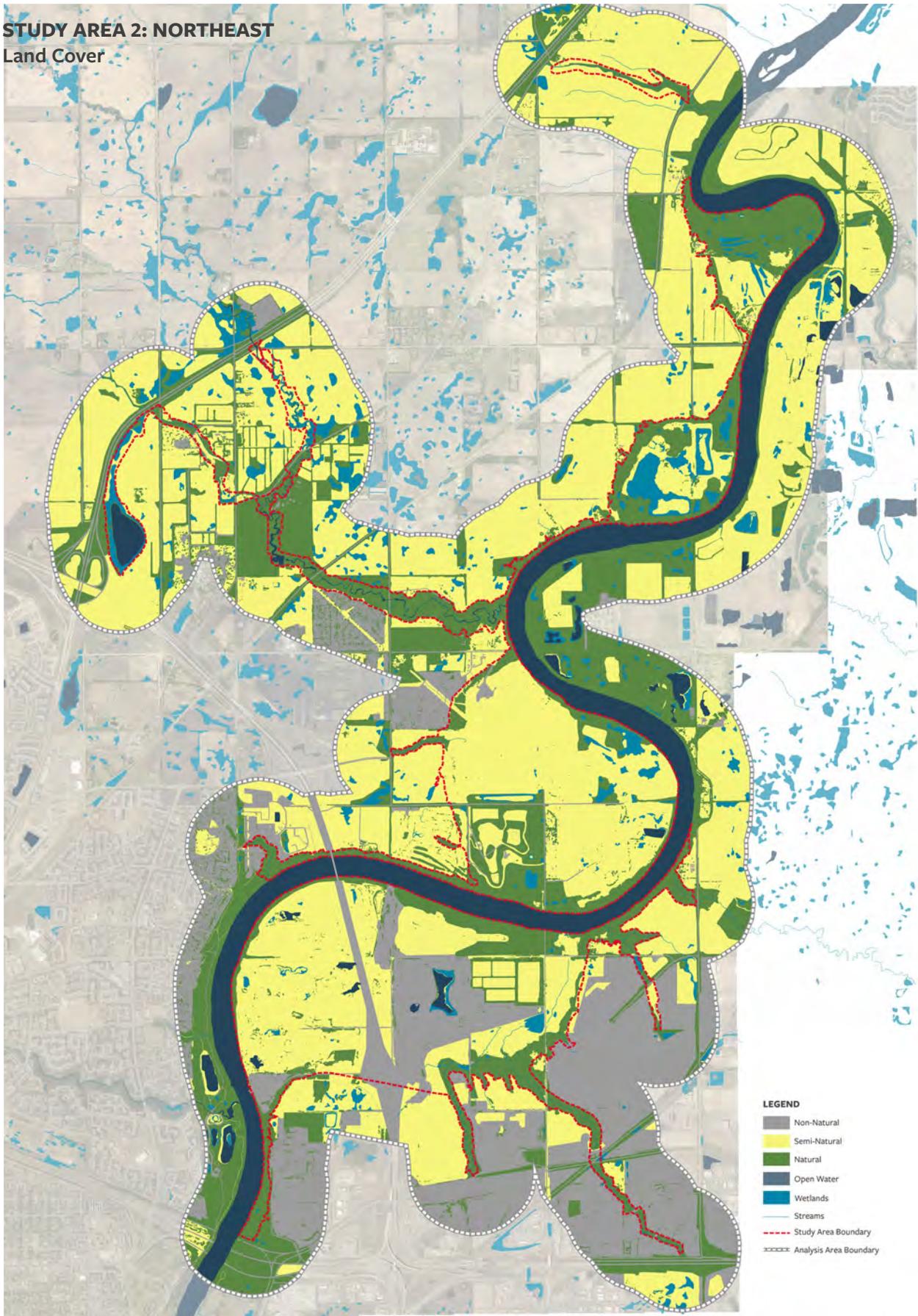


Figure 9. Northeast Study Area Land Cover

IMPORTANT WILDLIFE MOVEMENT AREAS

Important wildlife movement areas play a critical role in maintaining the natural functioning of an area, and the Ribbon of Green study area has been widely recognized as an essential connectivity corridor for the broader surrounding region. The maintenance of connectivity throughout the study area is of utmost importance. However, the movement of wildlife through the landscape is a difficult and complex subject to study, and is highly influenced by species-specific life history characteristics. In particular, detailed animal tracking information has not been collected in the Ribbon of Green area. However, it is still possible to arrive at a useful assessment of the degree to which the land cover found in a landscape may enhance or impede connectivity, and thus a general sense of the flow of wildlife movement through the area. Drawing on terrain and land cover information, an assessment of potential wildlife movement flow through the urban ecological network was conducted. For this, the Circuitscape model was adopted (McRae, et al., 2008) to estimate wildlife movement through the landscape.

The Circuitscape model employs the same calculation methods used to estimate the movement of electrons through a circuit to describe the likelihood of wildlife movement in response to “landscape friction” (i.e. the difficulty of moving across the land). O2 classified the landscape friction using broadly consistent wildlife responses: landscape elements which are typically avoided by many animals (loud, active, high traffic, impermeable or fenced areas); landscape elements which many animals find easy to move through (grasslands, forest, other natural cover types); and landscape elements which are often more difficult to move through (rock, bare earth, wetlands, disturbed areas). While individual species display a wide variety of idiosyncratic responses to land cover, these general responses are consistent across many species.

A 1m² cell size was used for the analysis to capture significant pinch-points surrounding urban areas. The summed result of this analysis is a single “current map” showing the relative likelihood of usage throughout the entire area. This identifies pinch points in the landscape, areas with a high relative likelihood of being used for movement through the area. These areas serve as important components of the naturally connected landscape, and recreational activities in these areas have an increased likelihood of human-wildlife conflicts.

The friction table to the right describes the relative valuation of land cover in the study area. Friction provides an estimate of the relative resistance to movement experienced by wildlife moving through land cover of that type, with friction increasing with the steepness of the slope. Friction values are estimated on a scale of 1 to 100, the higher the number the more friction.

LAND COVER	FRICITION
Non-Natural, Non-Permeable (Paved)	
Arterial (Rural)	45
Arterial (Urban)	79
Autocentric Commercial	82
Autocentric Industrial	80
Building	100
Collector (Commercial, Industrial, Residential)	75
Local Streets	63
Major Arterial (High Speed)	91
Major Arterial (Low Speed)	84
Sidewalk (Paved)	61
Trail (Paved)	39
Natural, Permeable	
Grass/Herbaceous	11
Natural WB	57
Poorly Vegetated	47
River Channel	57
River Tributary	18
Shrubs	16
Street Trees	55
Trees	7
Wetland (Ephemeral)	47
Wetland (Non-Permanent)	52
Wetland (Permanent)	57
Non-Natural, Permeable	
Chain Link	99
Chain Link with Barbwire	99
Decorative	11
Light Rail Transit (above ground)	70
Low Fence	6
Rail Line (main line)	73
Rail Line (spur line)	68
Urban Residential	57
Semi-Natural, Permeable	
Artificial WB (Non-Perm SWMF)	52
Artificial WB (Non-Permanent)	52
Artificial WB (Permanent)	57
Artificial WB (SWMF)	57
Cropland	16
Disturbed Land	75
Maintained Grass	13
Pasture	9
Rural Residential	55
Trail (Unpaved)	51

As the raw outputs of the circuit model are a continuous surface of probability, a method must be employed to highlight areas that have such a density of movement as to warrant special attention in the planning process. The continuous current flow output map was screened to select areas with a high relative current density, indicating a high likelihood of wildlife movement. There is a balance that must be maintained: if too low a current threshold is chosen, all of the study area becomes flagged as important, and the ability to discern more important areas is lost. Too high a threshold results in only very few areas highlighted, and important areas for movement may not be recognized.

As the average current density for the city was 4.85, a cut-off of 5 was chosen, highlighting those areas which play an important role in movement through the region: any area with a density greater than the cut-off was highlighted as an 'Important Wildlife Movement Area', and the area was converted to a polygon shape. These polygons were intersected with the Land Cover layer; those overlapping with natural land cover were classified into the Preservation classification, while those overlapping with semi-natural land cover were placed into the Conservation classification, to be considered for potential restoration efforts at a later date. In total, 26.4% of the study area falls within these movement area polygons. However, it is important to stress that the vast majority of the entire Ribbon of Green study area has been recognized as an essential connectivity corridor connecting the city with the surrounding region. All management efforts within the Ribbon of Green must ensure that connectivity is bolstered throughout the area.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Wildlife Movement Areas

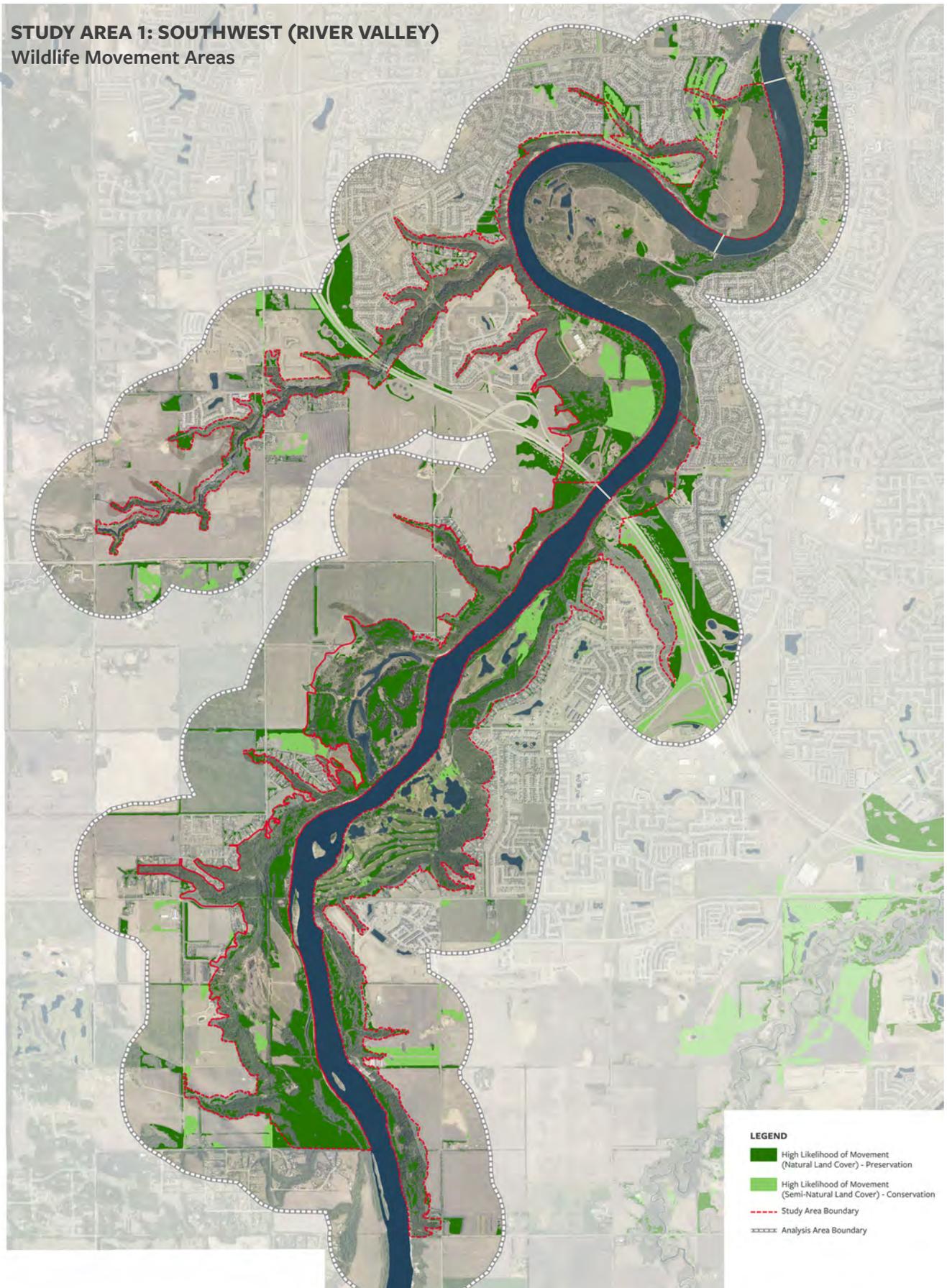


Figure 10. Southwest Wildlife Connectivity (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Wildlife Movement Areas

- LEGEND**
- High Likelihood of Movement (Natural Land Cover) - Preservation
 - High Likelihood of Movement (Semi-Natural Land Cover) - Conservation
 - Study Area Boundary
 - Analysis Area Boundary

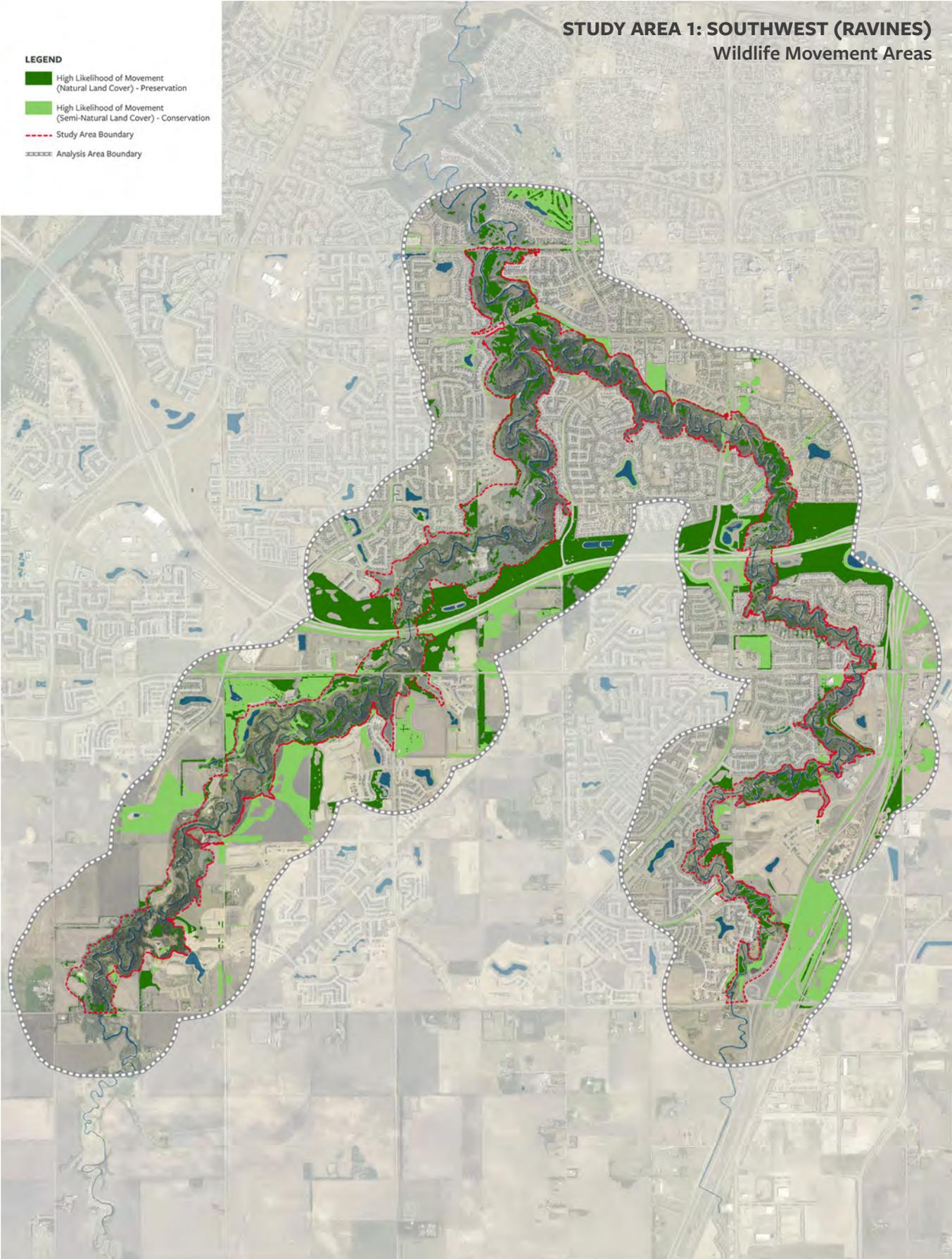
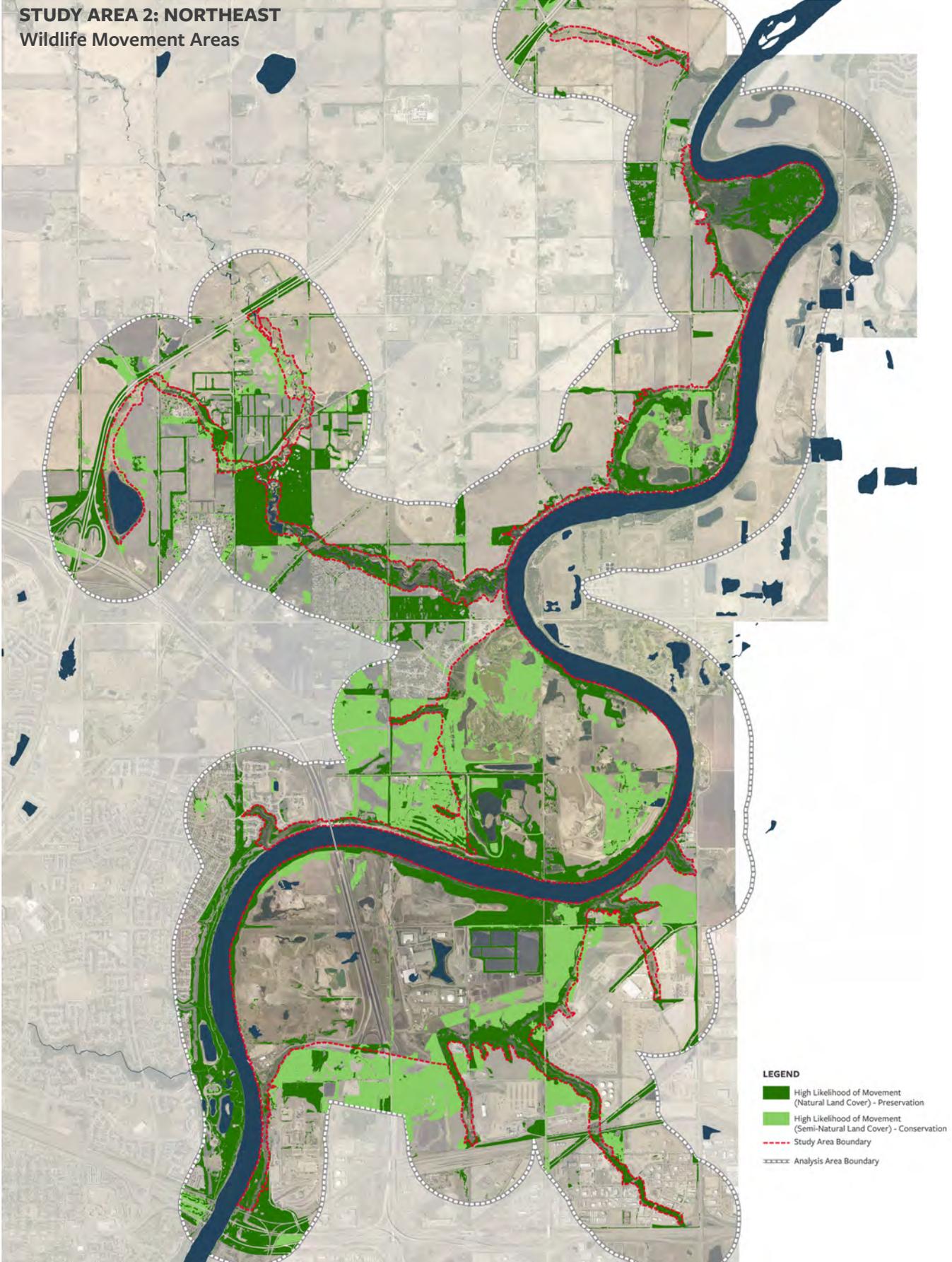


Figure 11. Northeast Wildlife Connectivity (Ravine)

STUDY AREA 2: NORTHEAST
Wildlife Movement Areas



- LEGEND**
- High Likelihood of Movement (Natural Land Cover) - Preservation
 - High Likelihood of Movement (Semi-Natural Land Cover) - Conservation
 - Study Area Boundary
 - Analysis Area Boundary

Figure 12. Northeast Wildlife Connectivity

ENVIRONMENTAL SENSITIVITY MODEL

The Environmental Sensitivity Model (ESM) dataset was developed by Solstice for the City of Edmonton. The goals of the ESM are to:

- Advance The City of Edmonton’s goal to protect, understand and restore its ecological network, as outlined in the Way We Grow (2010)
- Identify areas with significant ecological value (assets), threats to those valued assets, physical constraints and cultural resources
- Summarize these factors as “environmentally sensitive”
- Identify potential restoration sites

$$\text{MODEL OUTPUT SCORE} = \text{ASSETS} + \text{DEVELOPMENT CONSTRAINTS} - \text{THREATS}$$

The model used to develop this dataset was based on 26 different datasets describing ecological and physical assets, threats and development constraints. The figure on the following page describes the manner in which these datasets are combined to create a single Environmental Sensitivity scoring, which were further classified into Low, Moderate, High, Very High and Extremely High categories.

Based on the recommendations from the Environmental Sensitivity Report, O2 assigned areas based on the ESM classes. Extremely High and Very High Values from the ESM data were translated into the Preservation management classification; High and Moderate Values were translated into the Conservation class; and Low Value areas translated into the Active Working Landscapes/Intensive Recreation class.

ENVIRONMENTAL SENSITIVITY MODEL	RIBBON OF GREEN CLASS
EXTREMELY HIGH	Preservation
VERY HIGH	Preservation
HIGH	Conservation
MODERATE	Conservation
LOW	Active Working Landscapes/Intensive Recreation

ASSETS

(data source in brackets)

Vegetation	Item	Score
	Natural veg. (uPLVI, Soitice)	2
	Non-native vegetation (uPLVI, Soitice, CoE)	1
	Unique veg. (uPLVI)	1
	Rare Plants (ACIMS)	1
	Microclimate (Soitice)	1
	Possible max:	6

Wildlife Habitat	Item	Score
	Arboreal Connect. (Chicadee Circuitscape)	1
	Terrestrial Connect. (Coyote Circuitscape)	1
	Rare wildlife (ACIMS, FWMS)	1
	Possible max:	3

Aquatic Habitat	Item	Score
	Streams (Soitice)	2
	Wetlands (uPLVI, Soitice, GOA)	1
	River Habitat (RVA, FWMS, AEP, COP)	1
	Natural SWMF (CoE)	1
	Possible max:	2

Unique Land Forms	Item	Score
	Geomorphology (AGS, Soitice Rainies, Bylaw 188)	1
	Possible max:	1

Legally Protected	Item	Score
	Environmental Reserve (CoE)	2
	City owned Natural Area (CoE)	2
	Provincial (GOA, AEP)	3
	Possible max:	3

TOTAL

ASSETS

(Possible max score = 15)

Ecological Assets (Possible max score = 11)

Physical Assets (Possible max score = 4)



THREATS

(data source in brackets)

Vegetation	Item	Score
	Turf (CoE)	-1
	Parks Beds (CoE)	-1
	Possible max:	-1

Wildlife Habitat (Land Use)	Item	Score
	Very Low Human Use	0
	Low Human Use	-1
	High Human Use	-2
	Possible max:	-2

Aquatic Habitat	Item	Score
	Outfalls (CoE)	-1
	Traditional SWMF (CoE)	-1
	Possible max:	-1

Threats reduce value of ecological assets (thus subtracted where overlapping)

THREATS (Possible max score = -4)

CONSTRAINTS

(data source in brackets)

Slope (LIDAR)	Item	Score
	Major	2
	Moderate	1
	Minor	0
	Possible max:	2

Flood risk (GoA)	Item	Score
	Floodway	1
	Floodplain	2
	Possible max:	2

Cultural	Item	Score
	Cultural resource (AS Culture, RVA)	1
	Possible max:	1

Constraints (Max score = 5)



Environmental Sensitivity

(Max score = 20)

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Environmental Sensitivity Model

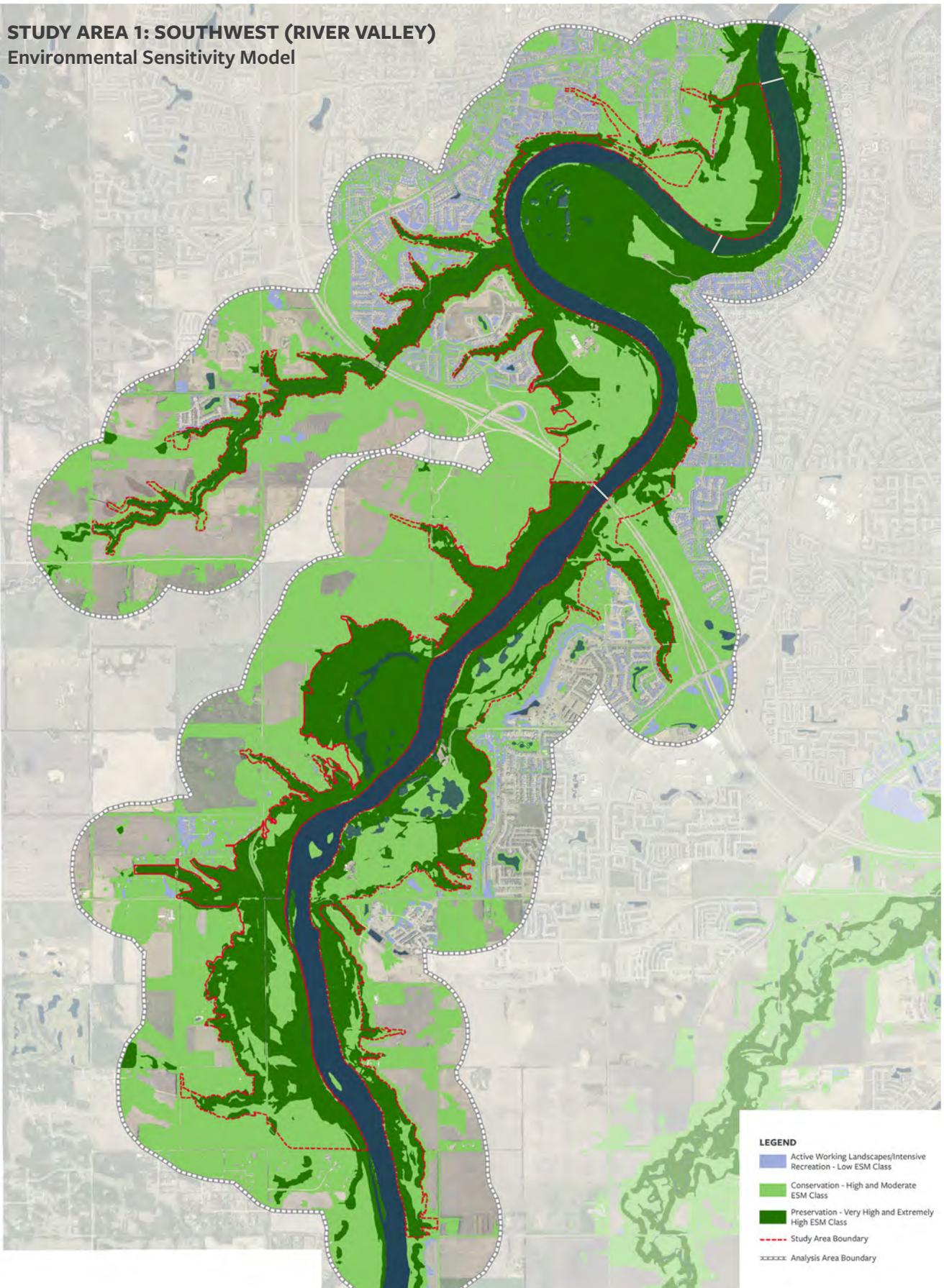


Figure 13. Southwest Ecology ESM (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Environmental Sensitivity Model

- LEGEND**
- Active Working Landscapes/
Intensive Recreation - Low ESM Class
 - Conservation - High and Moderate
ESM Class
 - Preservation - Very High and Extremely
High ESM Class
 - Study Area Boundary
 - Analysis Area Boundary

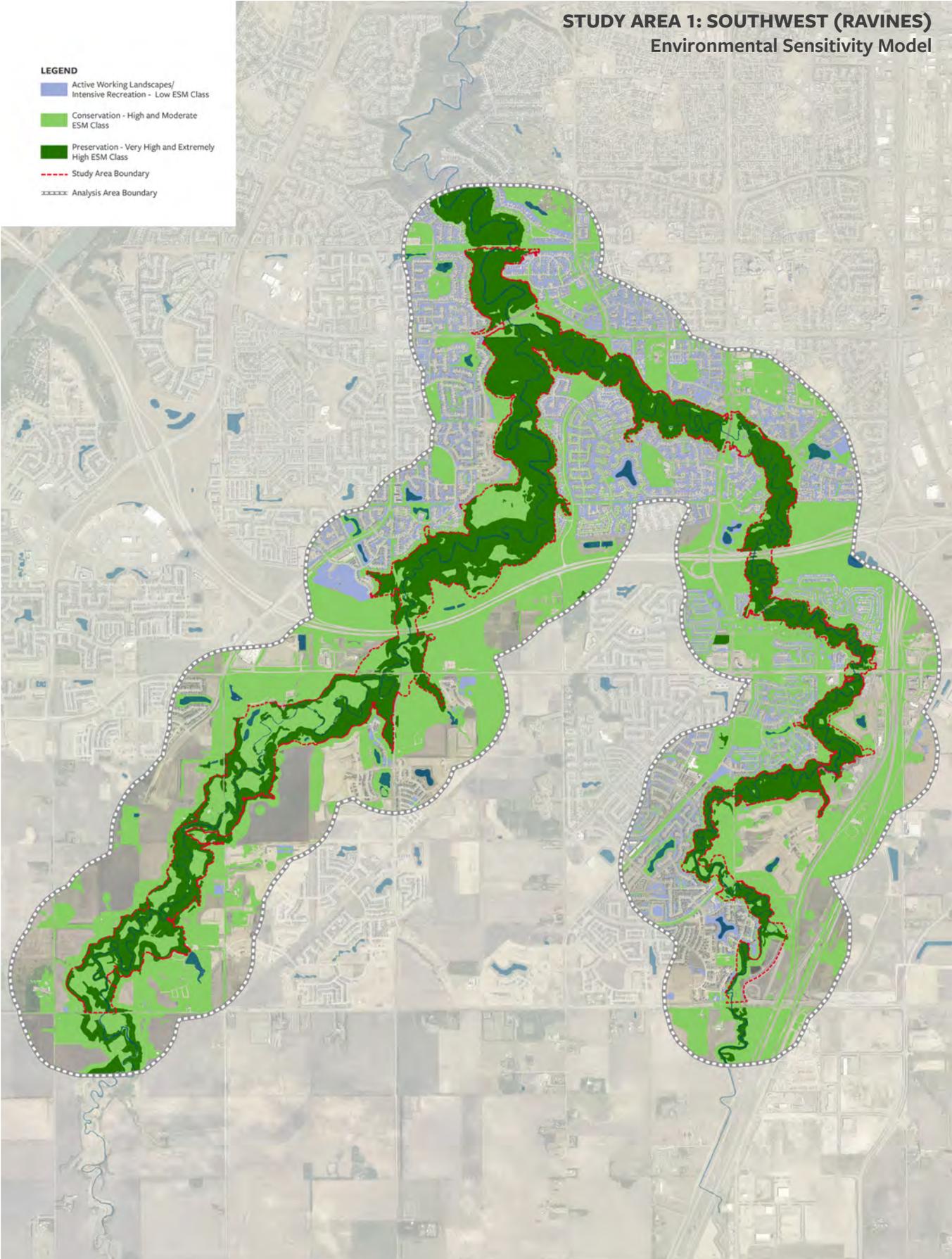


Figure 14. Southwest Ecology ESM (Ravine)

STUDY AREA 2: NORTHEAST
Environmental Sensitivity Model

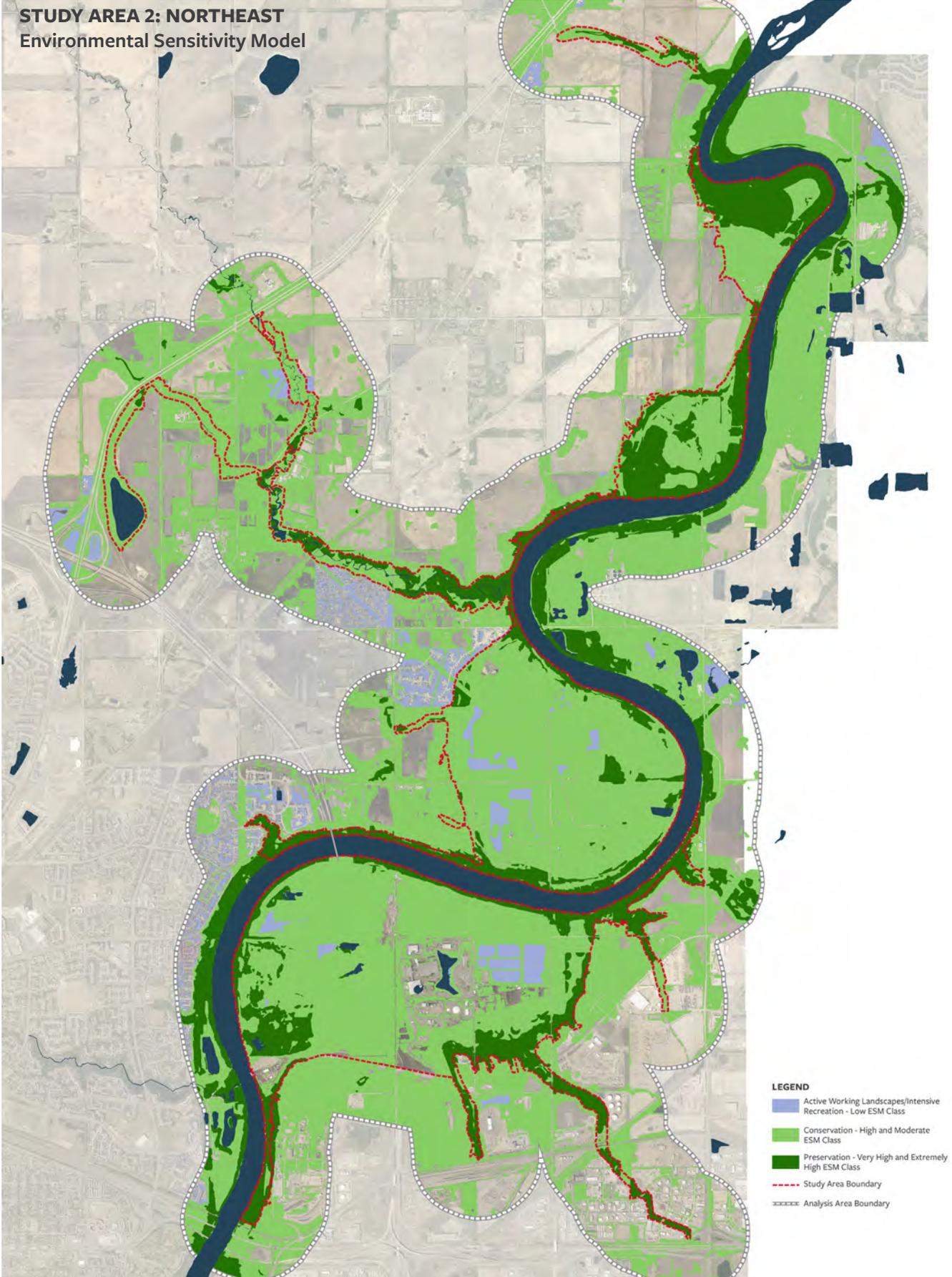


Figure 15. Northeast Ecology ESM

ARCHAEOLOGICAL POTENTIAL

An archaeological potential dataset was developed by Western Heritage for their Historic Resources Overview Report, who recommended classification of areas into Preservation, Conservation and Active Working Landscapes/Intensive Recreation based on the likelihood of the presence of important historic, cultural or archaeological artifacts.

Two datasets were used: a set of buffered (100m) point locations around areas of Known Archaeological Resources and Historic Sites, and a broader spatial assessment of Unknown Archaeological Resources (based on the anticipated probability of encountering or disturbing archaeological resources). Each resource was mapped and classified by Western Heritage according to the level of development impact the site could withstand (high, moderate or low/none). Subsequently, These findings were translated into Land Management Classifications. Areas with known highly valuable resources or with unknown resource potential which can only tolerate low impacts were assigned to Preservation. For Conservation, areas with known resources which can accommodate low to moderate impacts or areas with unknown resource potential, which can tolerate moderate impacts delineated.

To resolve overlaps, the Preservation classification was defined as the highest priority, overriding the others. The Conservation classification in turn overrides the Active Working Landscapes/Intensive Recreation classification.

Refer to the Ribbon of Green Historical Resources Overview for further detail.

PERCENTAGE OF AREA ALLOCATED PER CLASSIFICATION

STUDY AREA	PRESERVATION %	CONSERVATION %	ACTIVE WORKING LANDSCAPES/ INTENSIVE RECREATION %
SOUTHWEST (22.39 sq km)	82.1	17.31	0.59
NORTHEAST (20.28 sq km)	51.39	41.41	7.2

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Unknown Archaeological Potential

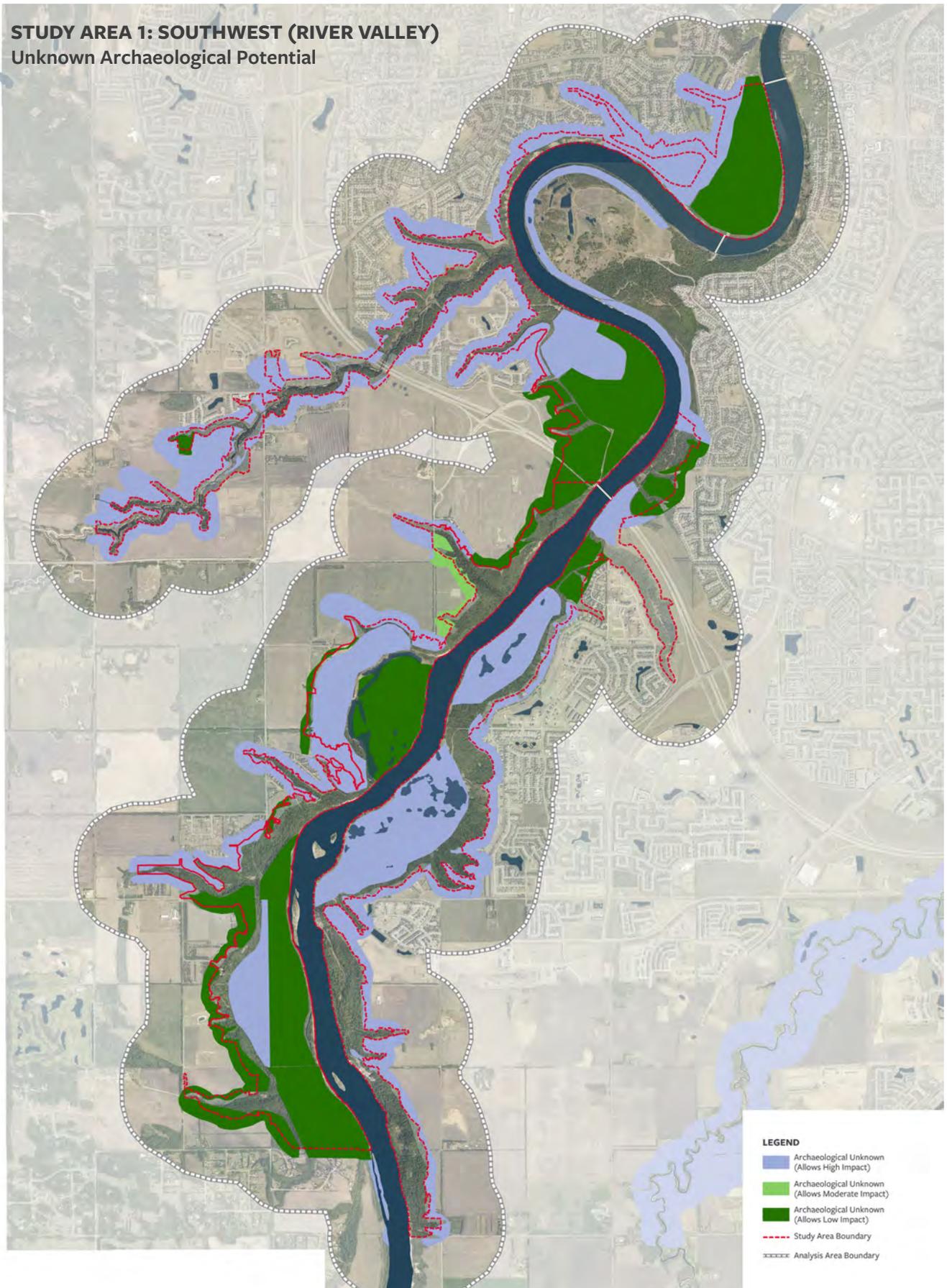


Figure 16. Southwest Historical Areas (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Unknown Archaeological Potential

- LEGEND**
- Historical Unknown Use
(Allows High Impact)
 - Historical Unknown - Conservation
(Allows Moderate Impact)
 - Historical Unknown - Preservation
(Allows Low Impact)
 - Study Area Boundary
 - Analysis Area Boundary

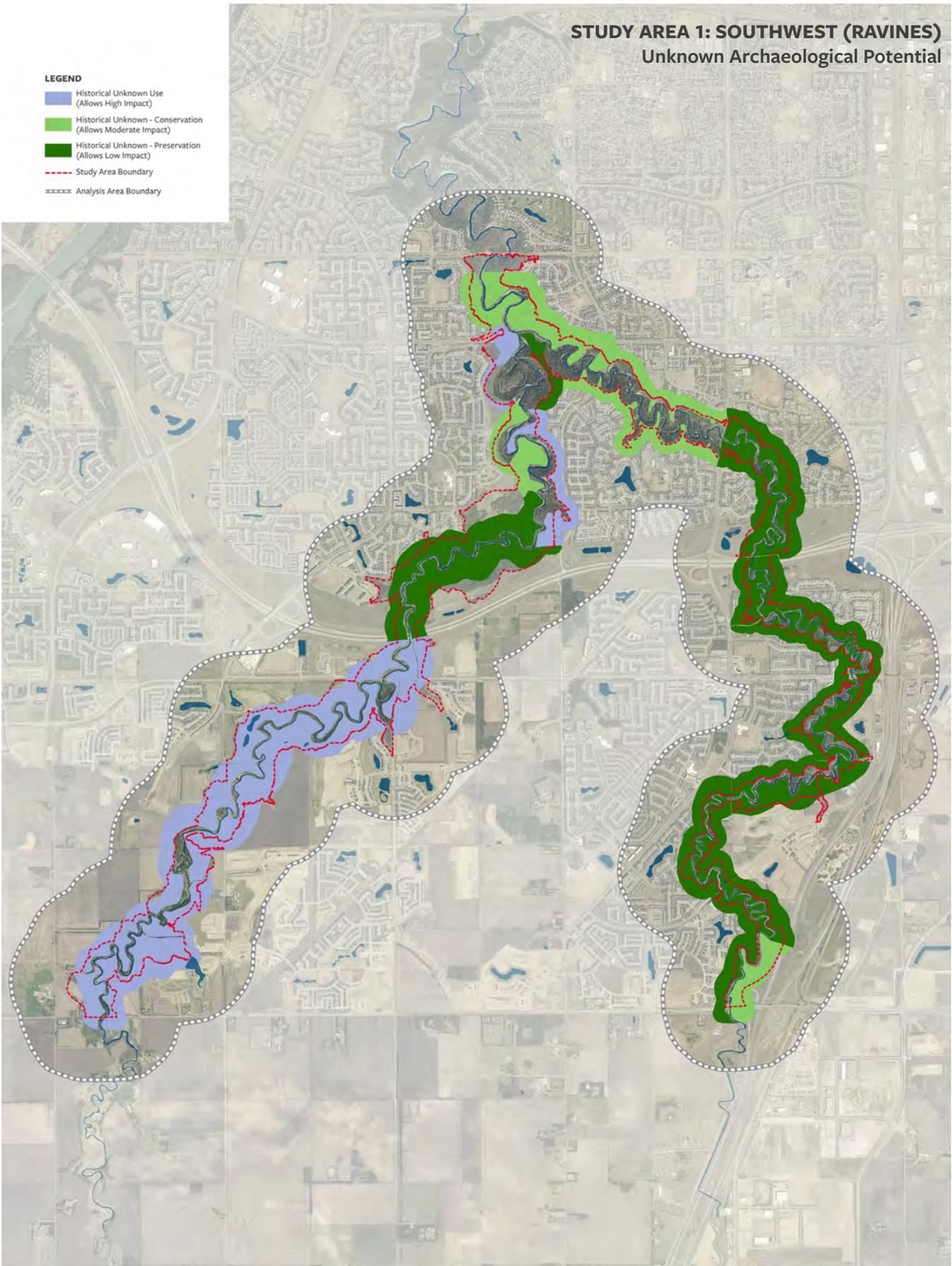


Figure 17. Southwest Historical Areas (Ravine)

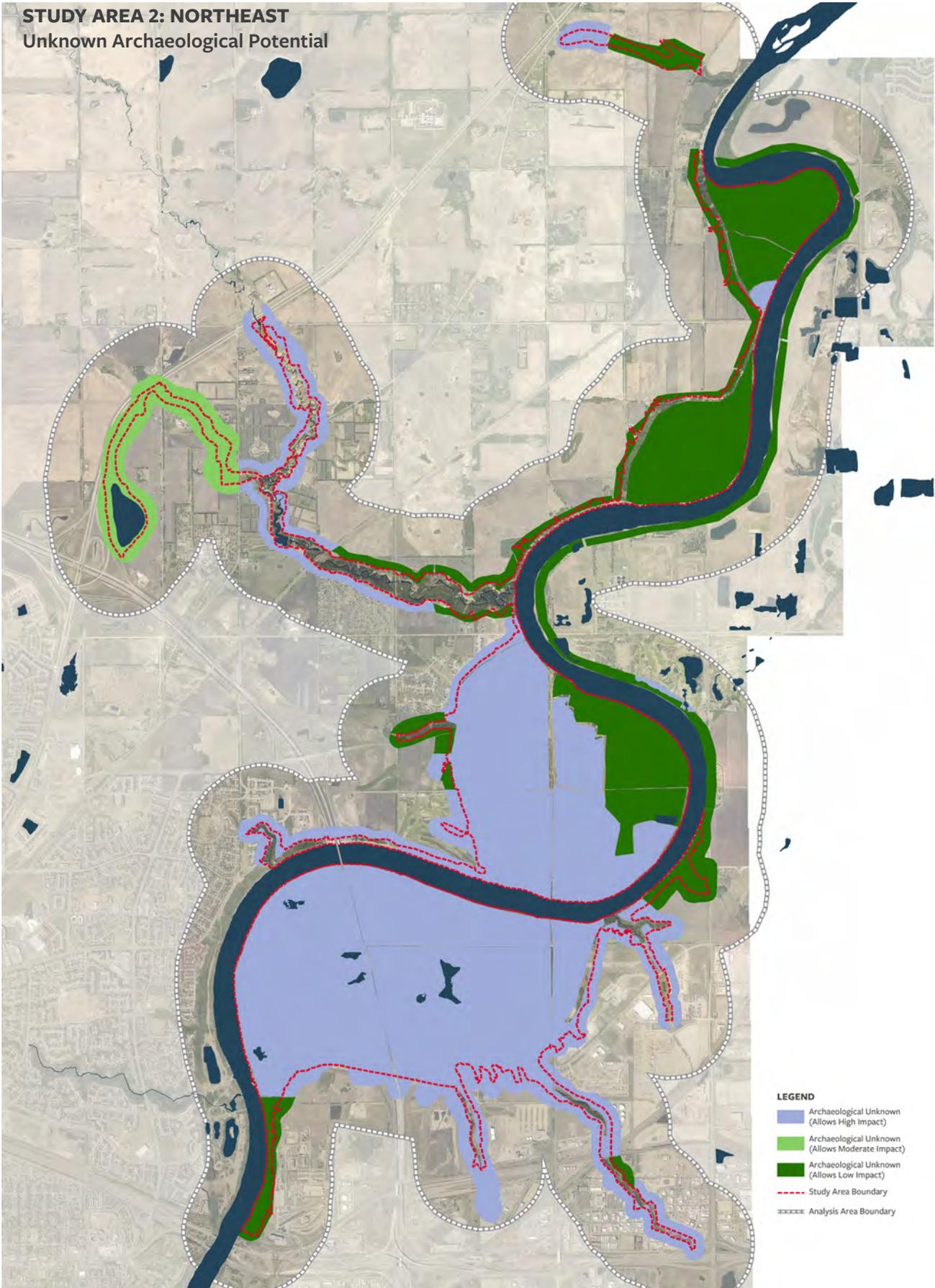


Figure 18. Northeast Historical Areas

THE CURRENT ECOLOGICAL NETWORK

The Ecological Network map summarizes the current ecological conditions of the study area and the region surrounding it. These maps are meant to provide an overall context for the project and highlight the current distribution of natural features in and around the study area. They provide a synthesis of the important existing features on the landscape which contribute to the natural functioning of the area. These maps include the following components:

- Wetlands and Open Water
- The Environmental Sensitivity Model (ESM) Extremely High and Very High Sensitivity Classes
- Natural Land Cover
- Unique or Rare Vegetation (Including all land cover classes with less than a total of 200 ha within the city limits)
- Important Wildlife Movement and Pinch Point Areas
- Expert-identified Important Existing Connections to the City's Green Network and to Surrounding Natural Areas that need to be considered in future planning

The ecological network map shows the overall ecological context, beyond the datasets that inform the Land Management Classifications. These maps are adapted from the BREATHE: Green Network Strategy's ecological network maps with additional information about wildlife connectivity, including important connections to areas outside the Ribbon of Green. The maps highlight the ecological significance of the lands in and around the study area (e.g. wetlands, areas of high wildlife movement likelihood, extremely high and very high ecological sensitivity, areas with natural land cover etc.) Information shown on these maps represents a snapshot of ecological value in the area, based on available data. Since this data has not necessarily been collected as part of a detailed inventory of the area, the absence of data does not necessarily guarantee the absence of ecological value. Finer scale on-site assessment will always be necessary prior to development or other disturbance, to ensure that ecological function is not unexpectedly compromised.

To guide restoration, the Important Wildlife Movement Areas and Pinch Points on the map highlight important areas to focus efforts, particularly in locations without natural land cover. This will ensure that these areas are not compromised during future development and programming. Restoration guidance needs to be provided at two scales - the first is at a regional scale to provide areas of focus (i.e. such as these Ecological Network Maps) and the second is at the site-specific scale to protect defined locations and shape future design and use. The other information in these network maps will also ensure that large regional ecological patterns are considered and respected locally during future site-specific planning.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Current Ecological Network

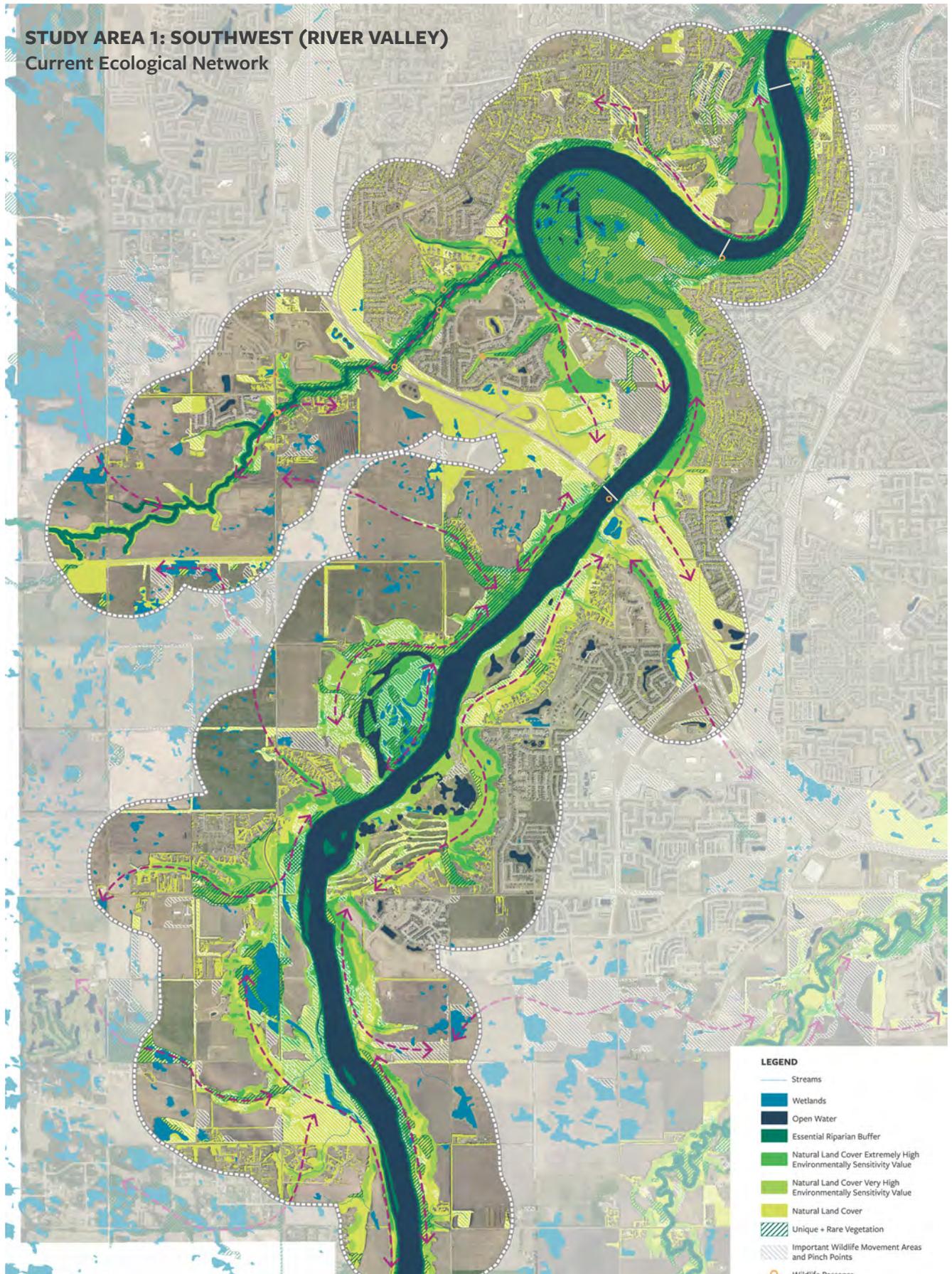


Figure 22. Southwest Ecological Network (River Valley)

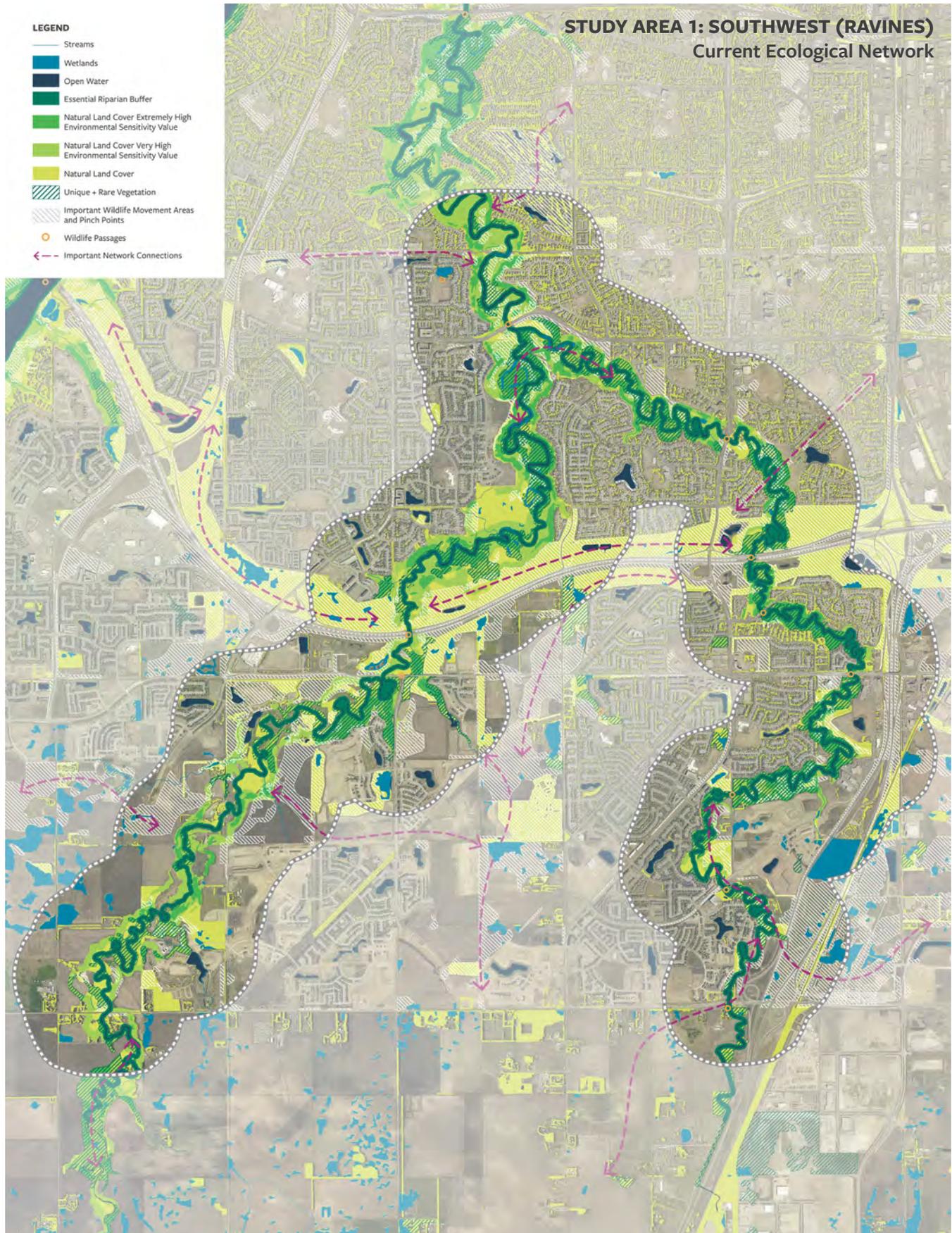


Figure 23. Southwest Ecological Network (Ravine)

STUDY AREA 2: NORTHEAST
Current Ecological Network

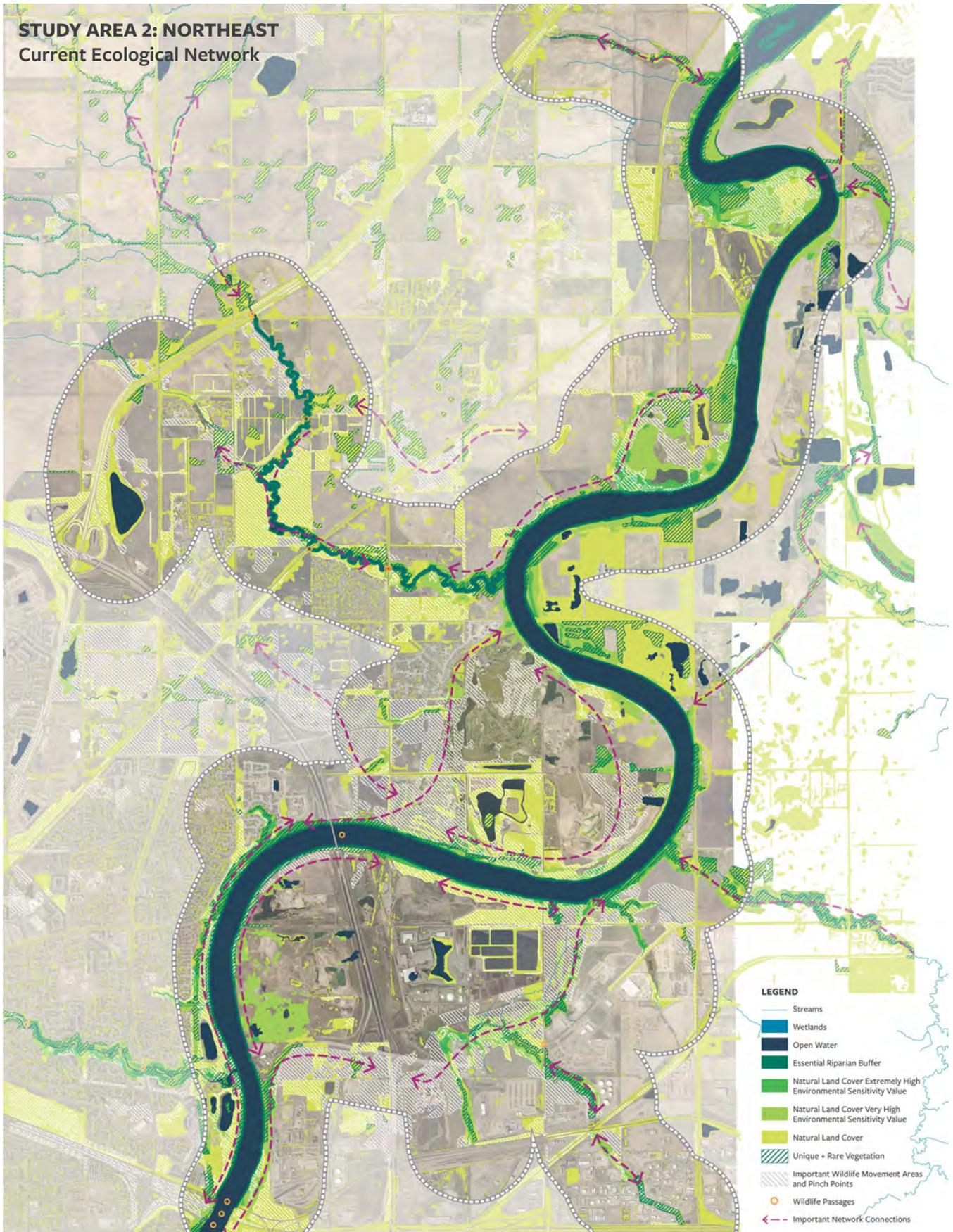
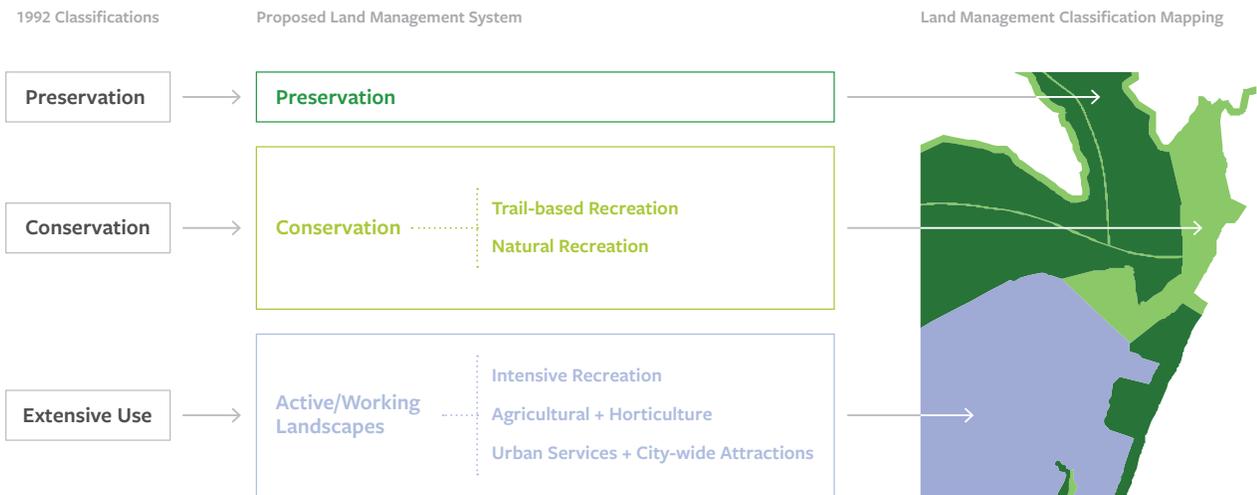


Figure 24. Northeast Ecological Network

LAND MANAGEMENT CLASSIFICATION AND DELINEATION

Land Management Classifications define the physical site conditions, operations, activities and amenities within the entire River Valley and Ravine System. These management classifications outline the level of protection or permitted development within each area.

In turn, these classifications will guide design and programming decisions to create park amenities and operations standards appropriate to their location within the River Valley and Ravine System. The Land Management Classifications are based on the original Ribbon of Green Master Plan from 1992. The feedback received from the first stage of public engagement, best practice research and site analysis helped inform the modernization and revisions to the original 1992 management units.



The Land Management Classification was a two part process and this chapter provides an overview of this process:

PART 1: Data-Derived Land Management Classifications: The initial identification of Land Management Classifications was developed using the following datasets (as described in the “Dataset Overview” chapter):

- **Landslide risks** from the geotechnical assessment, drawing on LiDAR and aerial imagery to identify where slopes had previously been compromised.
- **Land Cover + Wildlife Movement Likelihood** drawing on land cover information to assess the difficulty in moving through the landscape, identifying pinch points where expected movement is most likely.
- **Environmental Sensitivity Model (ESM)** which makes recommendations for the appropriate classifications, based on a 26 individual datasets.
- **Archaeological Potential** drawing from expert recommendations, identifies known and likely locations of cultural and archaeological finds.

Data from each component discussed in the “Dataset Overview Chapter” was assigned a Land Management Classification based on their sensitivity (e.g. Landslide Risk areas were assigned to Preservation). Each dataset individually allocates portions of land into Preservation, Conservation, and Active Working Landscapes/Intensive Recreation categories, based on the recommendations of the experts who created the data, as mentioned in the above sections. These were then consolidated into a single Land Management Classification Map.

PART 2: Manual Refinement of Land Management Classifications: After delineating the Land Management Classifications using the data available, a manual refinement was required to reflect past, existing and planned conditions, uses and accesses. Modifications to the management classifications were implemented where necessary to allow for current uses and existing and future recreation nodes as well as to provide additional buffering and protection to sensitive areas.

The following three principles provided a basis for the manual refinements:

1. Direct activity to areas with lower ecological value – all land in the River Valley and Ravine System is important and future planning for all Land Management Classifications will need to protect its ecological integrity. To minimize the impact on this ecological integrity, recreational opportunities are focused in areas with lower ecological value.
2. Concentrate activity in already disturbed areas – given the large amount of intact land in the River Valley and Ravine System it is important to focus programming and development in areas that are already disturbed.
3. Focus activity, when possible, in areas with good access (roads, trails etc.) – due to the steep and delicate slopes within the River Valley and Ravine System, it is prudent to focus future recreational activity in areas with accesses in place, for vehicles, bicycles and/or pedestrians.

The manual refinements, described later in this chapter, elaborate on how each of these three principles is reflected in the draft Land Management Classifications.

DATA-DERIVED LAND MANAGEMENT CLASSIFICATION

Individual data layers (described in previous sections - landslide risks, land cover + wildlife connectivity, ESM, archaeological potential and the high-level trail network) were unioned together, with the combined classification taking the most restrictive category, Preservation > Conservation > Active Working Landscapes/Intensive Recreation. An area is allocated into Preservation if any of the associated data layers included a Preservation recommendation. Similarly, Conservation areas had at least one dataset recommend the Conservation class (and no Preservation recommendations). Active Working/Landscapes are restricted to those areas with neither Preservation nor Conservation.

This preliminary classification informed the development of the plan for the study area. Modifications to the management classifications were implemented where necessary to allow for the intended uses of particular recreation nodes, or to provide additional buffering and protection to sensitive areas. Modifications which additionally allocated the Active Working Landscapes/Intensive Recreation classification were made during workshop consultation with the city, with reference to expert-based feasibility assessments, opportunities to tie into existing access points, and balanced against the ecological datasets, preferentially avoiding steep slopes, sensitive ecological features and wet areas.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Data-Derived Land Management Classifications

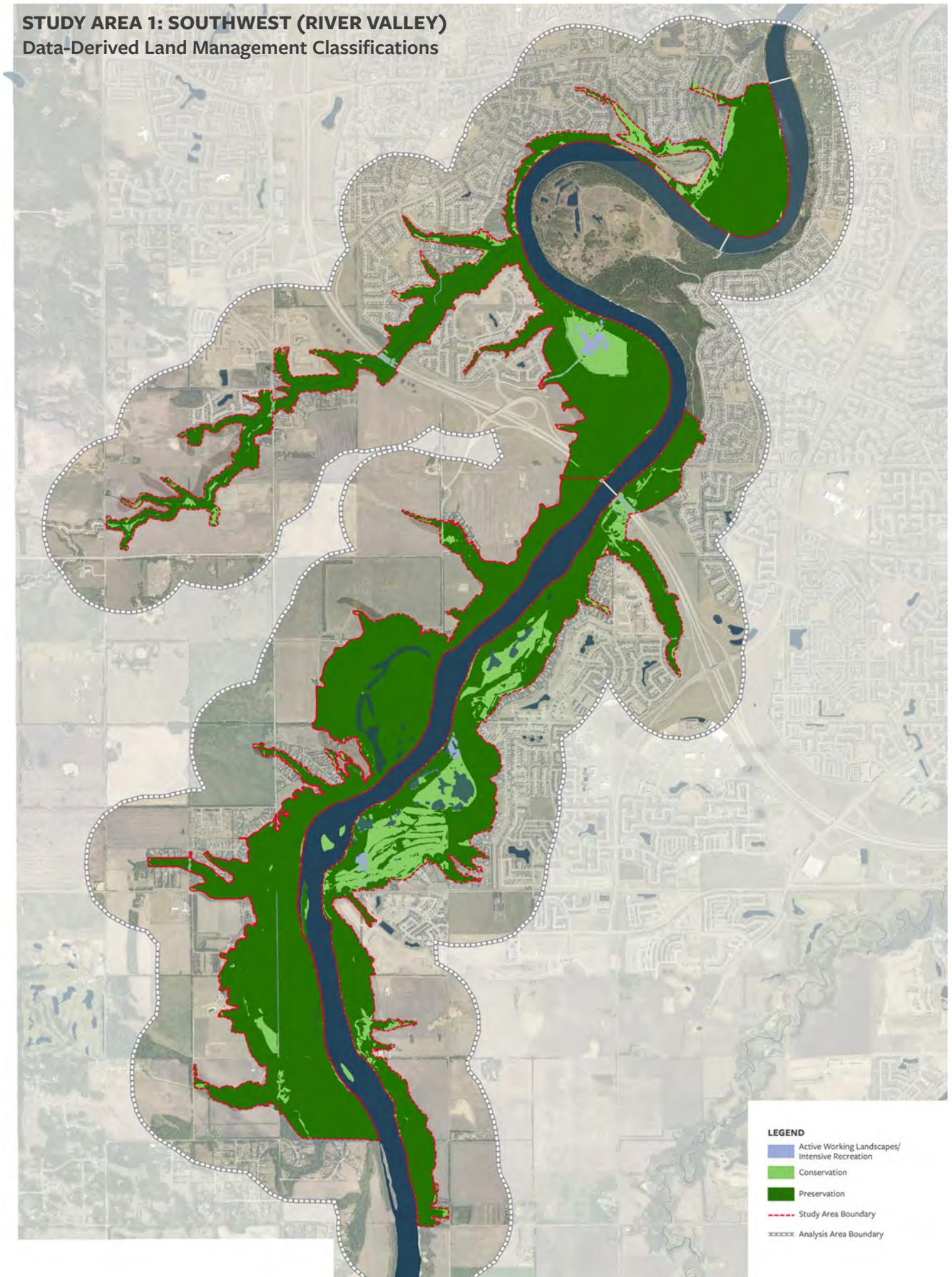


Figure 25. Southwest Data-Derived Land Management Classification (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES) Data-Derived Land Management Classifications

- LEGEND**
- Active/Working Landscapes
 - Conservation
 - Preservation
 - Study Area Boundary
 - Analysis Area Boundary

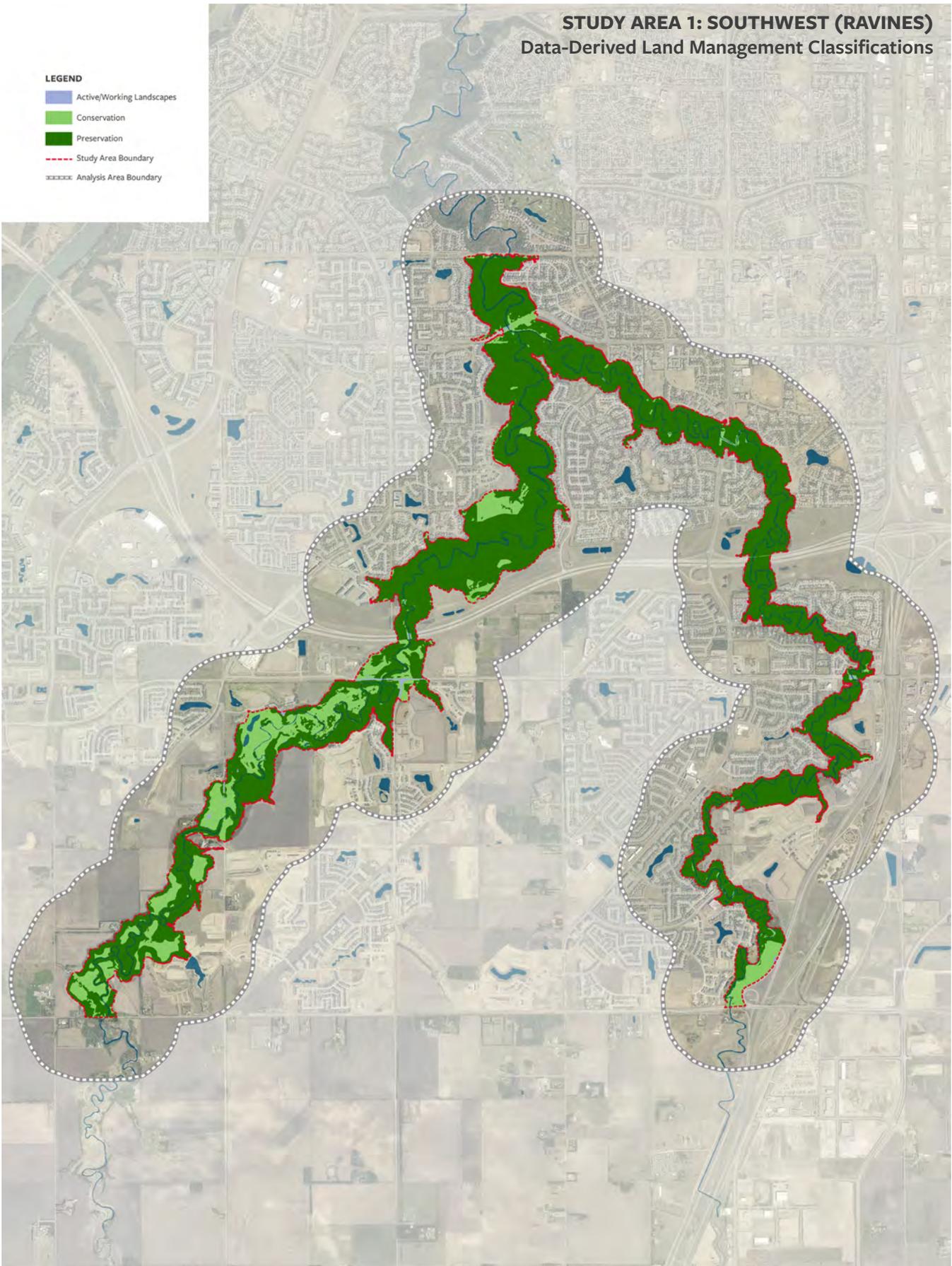


Figure 26. Southwest Data-Derived Land Management Classification (Ravine)

STUDY AREA 2: NORTHEAST
Data-Derived Land Management Classifications

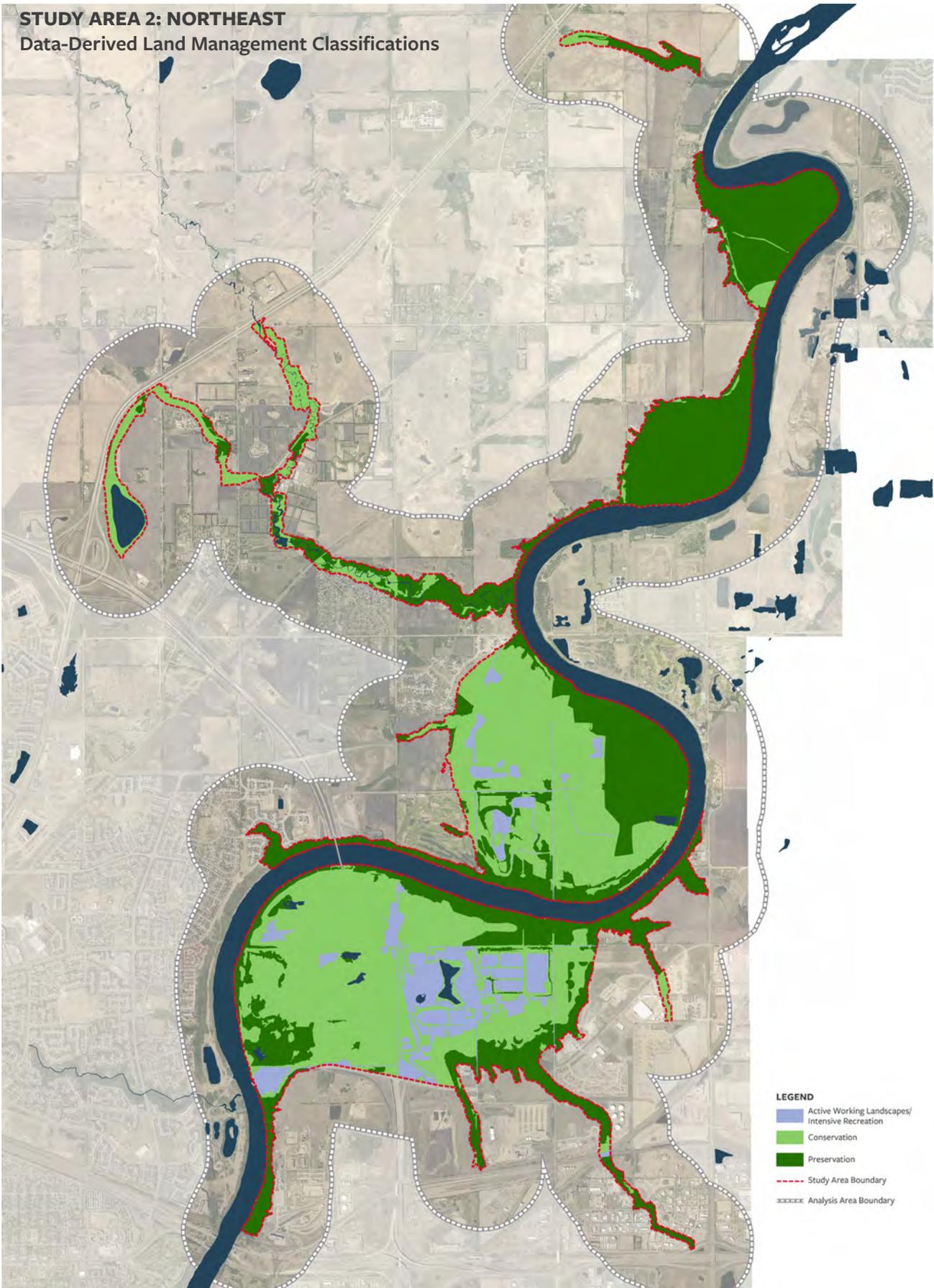


Figure 27. Northeast Data-Derived Land Management Classification

MANUAL REFINEMENT OF LAND MANAGEMENT CLASSIFICATIONS

When planning both study areas, it is important to consider the anticipated population growth around each study area: approximately 300,000 in the SW and 150,000 in the NE. This is in addition to the anticipated overall growth within the City and increasing demand for River Valley and Ravine System opportunities, which is a city-wide asset. Coupled with the ongoing challenge of user-generated trails (natural trails developed by individuals that are not planned or maintained by the City of Edmonton), recreational and access opportunities in the River Valley and Ravine System are and will continue to be in high demand. This requires careful planning to protect significant areas while accommodating recreation.

After generating the data-derived classification, a manual refinement of the Land Management Classifications occurred to account for land use (planned and existing) and access. These manual refinements are described below:

CONVERSION TO PRESERVATION

- Whenever possible, areas that were recommended by the data-derived analyses for Preservation were retained, with adjustments introduced only to provide recreational opportunities (as described below) or acknowledge an existing use.
- Forested areas which were classified as Conservation areas were changed into Preservation areas to fill gaps and create a more contiguous and easily protected set of Preservation areas.
- Buffers of 30m on both sides of rivers and creeks were classified as Preservation. Policies will guide further refinement of buffers in more detailed planning stages.

CONVERSION TO CONSERVATION

- A 12 m Conservation buffer was added around the top-of-bank, to ensure that proposed top-of-bank trails and other developments in the surrounding neighbourhoods are partitioned from the preservation areas in the river valley itself.
- Conservation buffers around Preservation areas were applied when appropriate and feasible to minimize disturbances to the Preservation areas. Their size and shape was determined by terrain and land cover.

CONVERSION TO ACTIVE WORKING LANDSCAPES/INTENSIVE RECREATION

- **Principle 1: Direct activity to areas with lower ecological value** – There are locations throughout the River Valley and Ravine System that were previously used for agriculture and other purposes that are now areas of semi-natural vegetation (land cover disturbed as a result of human activity, such as former agricultural land). When these semi-natural areas do not contain any or contain only limited amounts of significant riparian areas, unique or rare vegetation or important wildlife movement areas they provide an opportunity for more recreational activity without disturbing more sensitive areas. It is in these areas that Active/Working Landscapes have been located, specifically, within Oleskiw River Valley Park and the eastern portion of Woodbend Natural Area.
- **Principle 2: Concentrate activity in already disturbed areas** – In both study areas, there are locations that are currently being used for purposes other than parks or natural protection. Specifically, the following are used for industrial, recreational and agricultural purposes:
 - The E.L. Smith Water Treatment Plant
 - Riverbend Gardens
 - The Edmonton Waste Management Centre
 - Windermere Golf and Country Club, Rivers Edge Golf and Country Club, Edmonton Country Club and Golf Course, Jagare Ridge Golf Club, Raven Crest Golf and Country Club, and The Quarry Golf Club
 - The aggregate mines in the northeast are disturbed areas in current use.

Since the current use of these sites is in alignment with the Active/Working Landscape classification these areas were re-classified to ensure that they are in alignment with the Ribbon of Green. However, in the next stage of the project the Ribbon of Green will delineate the recommended ecological network. At that time policy will be developed to ensure that restoration occurs at identified sites if they cease to be needed/used for their current purpose.

- **Principle 3: Focus activity, when possible, in areas with good access (roads, trails etc.)** – Given the slopes and sensitivity of the Ribbon of Green, and thus the limited opportunities to provide access into the River Valley, it is important to take advantage of existing access points to focus activity:
 - Since 199 Street goes through the Woodbend Natural area, an area of Active/Working Landscapes is defined on the east side of the road to provide recreational opportunities.
 - Existing trail access and paved areas in the Old Klondike Campground (converted to Conservation and some Active Working Landscapes) provide a location to focus future recreational opportunities.
 - Grandisle Road (currently a private road) could, in the future, connect to the southern part of Big Island (converted to Conservation).
 - Like Big Island, an area within the southernmost section of the South Whitemud Ravine (converted to Active/Working Landscapes) currently has private road access that in the future can potentially accommodate public access.
 - There are also instances of current and future road crossings that were reclassified as Active/Working landscapes to accommodate this function.

Like with all other sites converted to Active/Working Landscapes, it is important to plan for ecologically sensitive design and programming and restore areas whenever possible.

The following maps have highlighted the location of each adjustment from the Data-Derived Land Management Classifications made during the Manual Refinement of Land Management Classifications.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Manual Adjustments to the Land Management Classifications

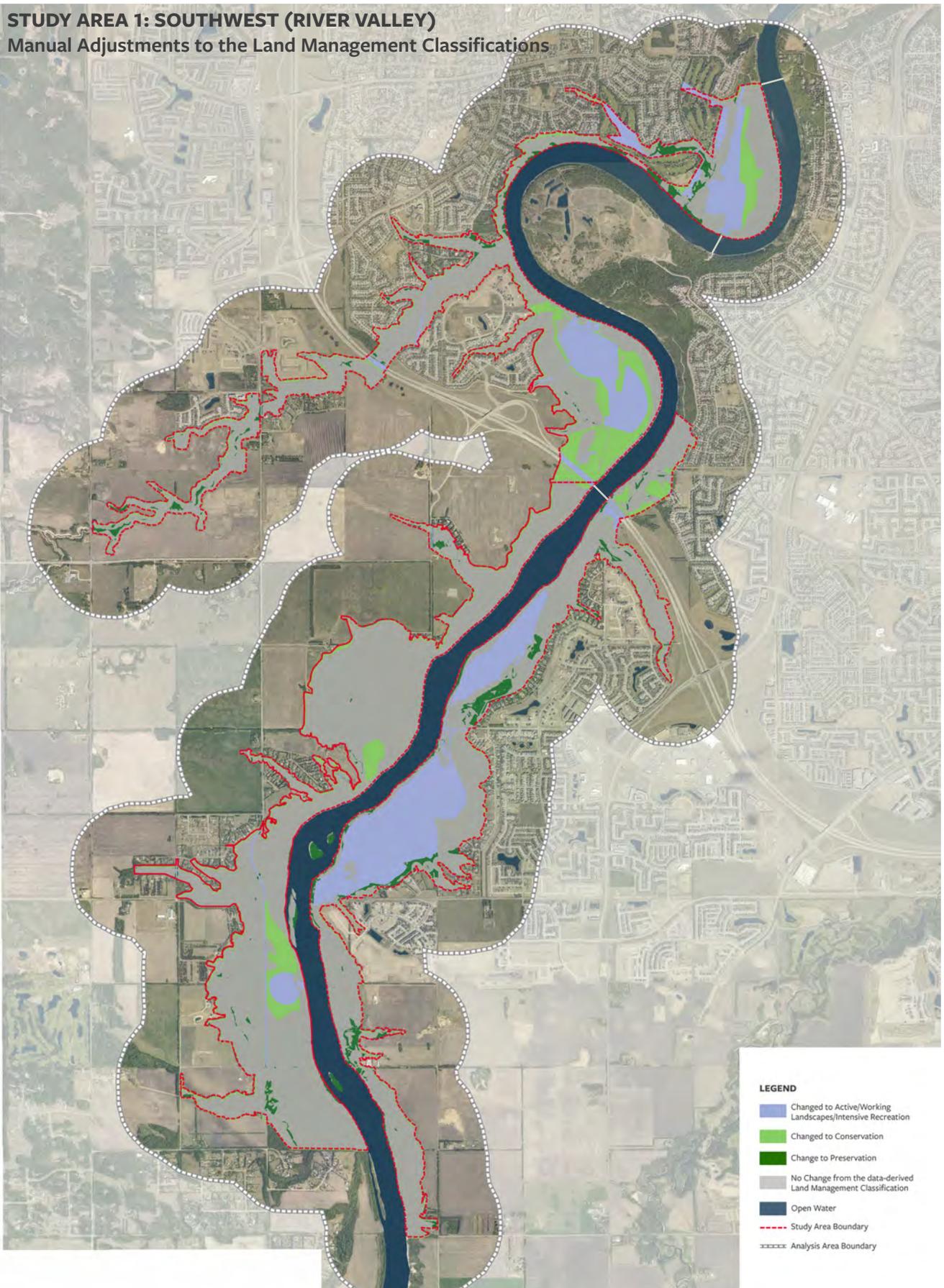


Figure 28. Southwest Adjusted Management Classification Areas (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)

Manual Adjustments to the Land Management Classifications

LEGEND

- Changed to Active/Working Landscapes/Intensive Recreation
- Changed to Conservation
- Change to Preservation
- No Change from the data-derived Land Management Classification
- Open Water
- Study Area Boundary
- Analysis Area Boundary

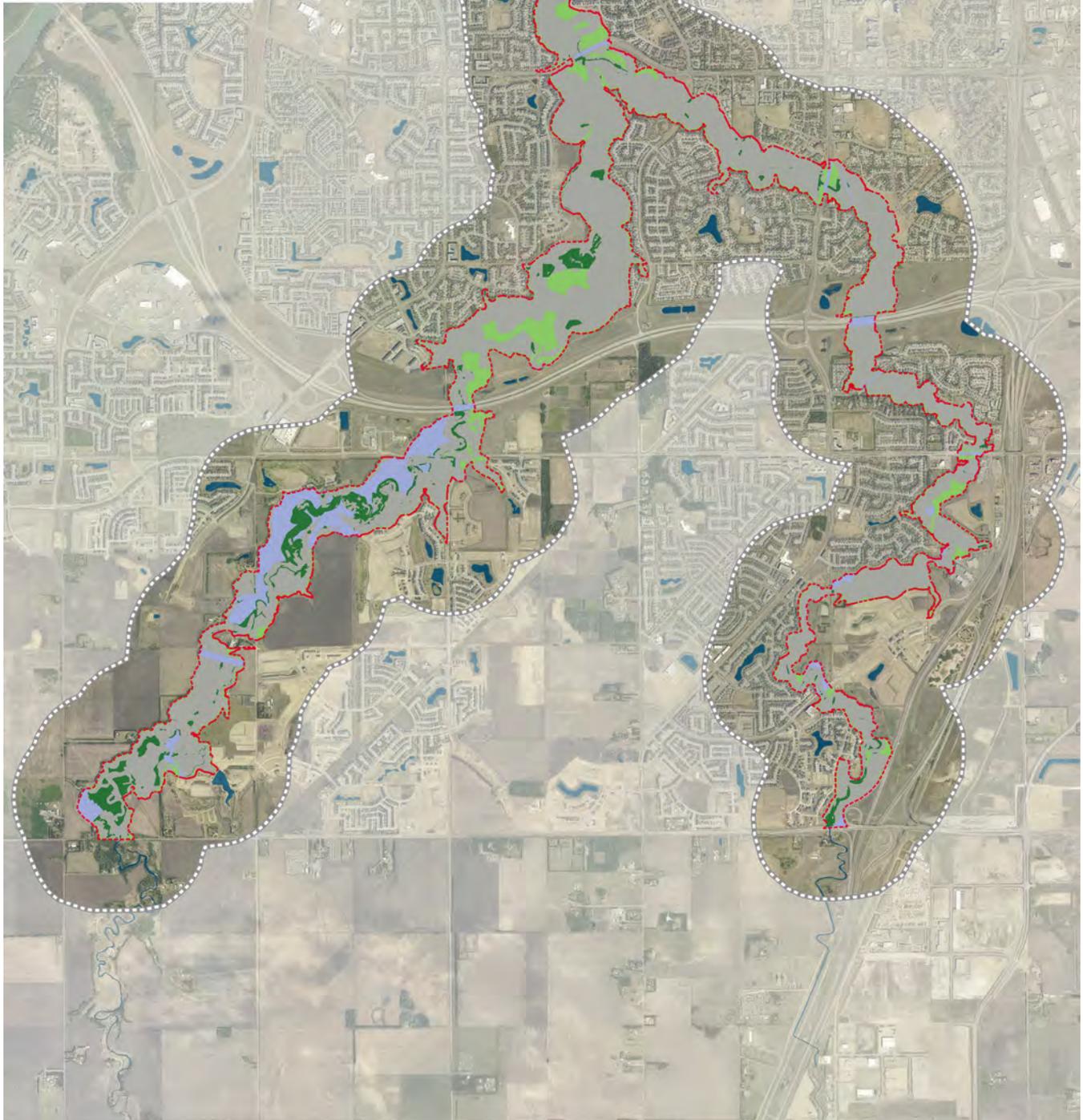


Figure 29. Southwest Adjusted Management Classification Areas (Ravine)

STUDY AREA 2: NORTHEAST
Manual Adjustments to the Land Management Classifications

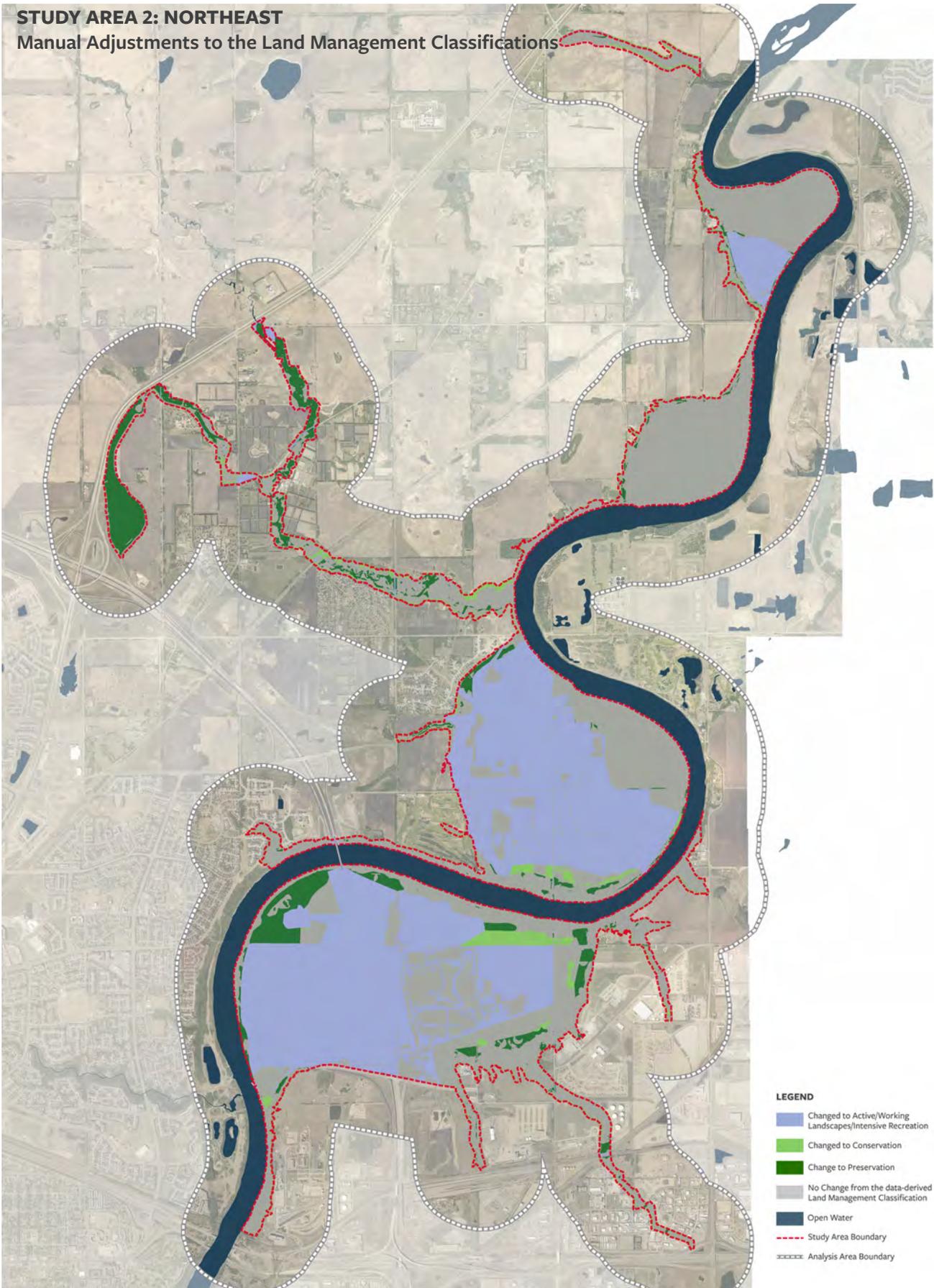


Figure 30. Northeast Adjusted Management Classification Areas

PROPOSED LAND MANAGEMENT CLASSIFICATION

Existing datasets, consultation with the client and detailed expert evaluation informed the delineation of the Land Management Classification. This delineation broadly classifies areas into Preservation, Conservation and Active Working Landscapes/Intensive Recreation. Any further refinement based on site conditions and the application of sub-classifications will be spatially denoted during more fine-scale planning stages.

STUDY AREA 1: SOUTHWEST (RIVER VALLEY)
Proposed Land Management Classifications

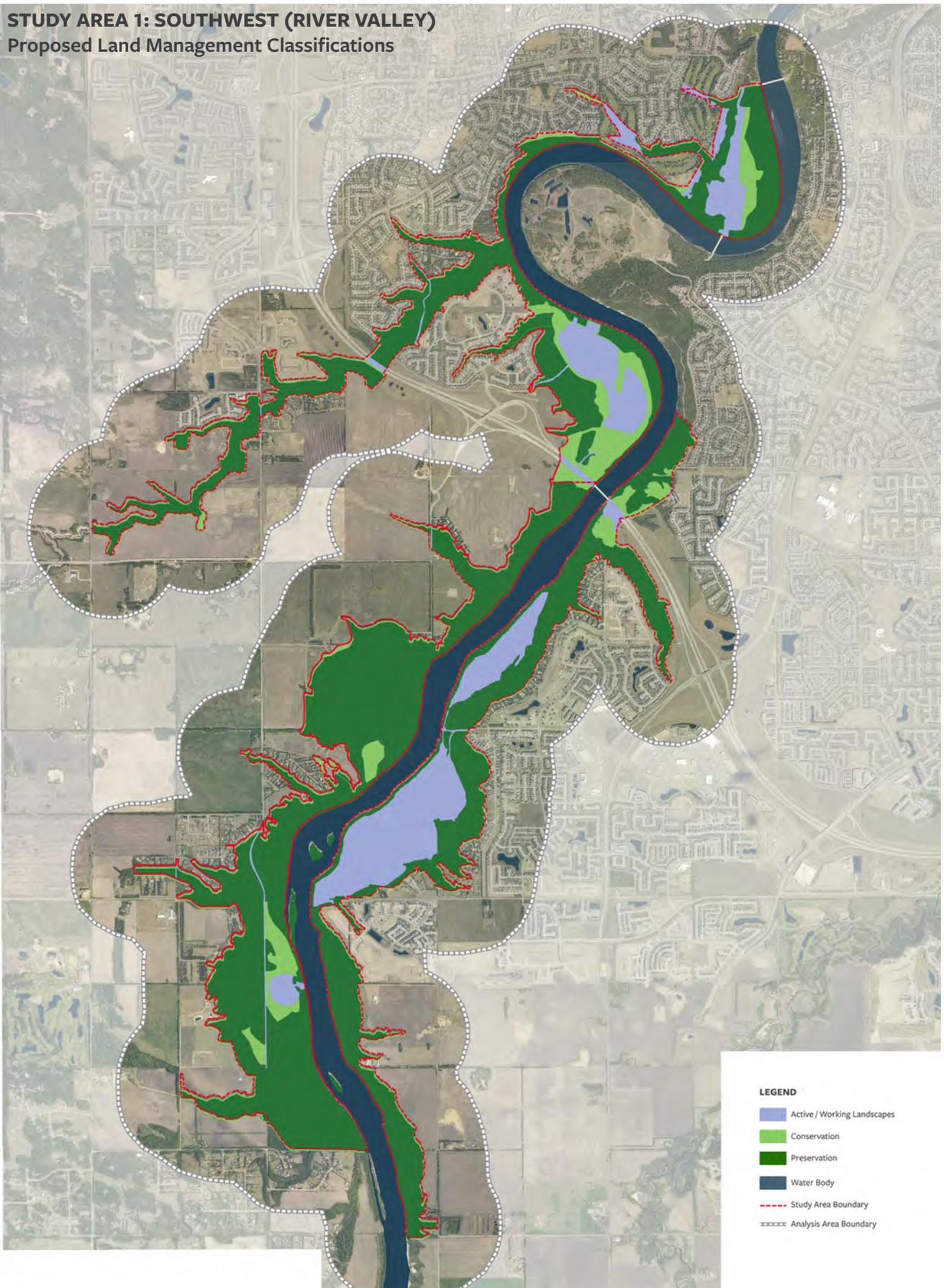


Figure 31. Southwest Management Classification (River Valley)

STUDY AREA 1: SOUTHWEST (RAVINES)
Proposed Land Management Classifications

- LEGEND**
- Active Working Landscapes/
Intensive Recreation
 - Conservation
 - Preservation
 - Study Area Boundary
 - Analysis Area Boundary

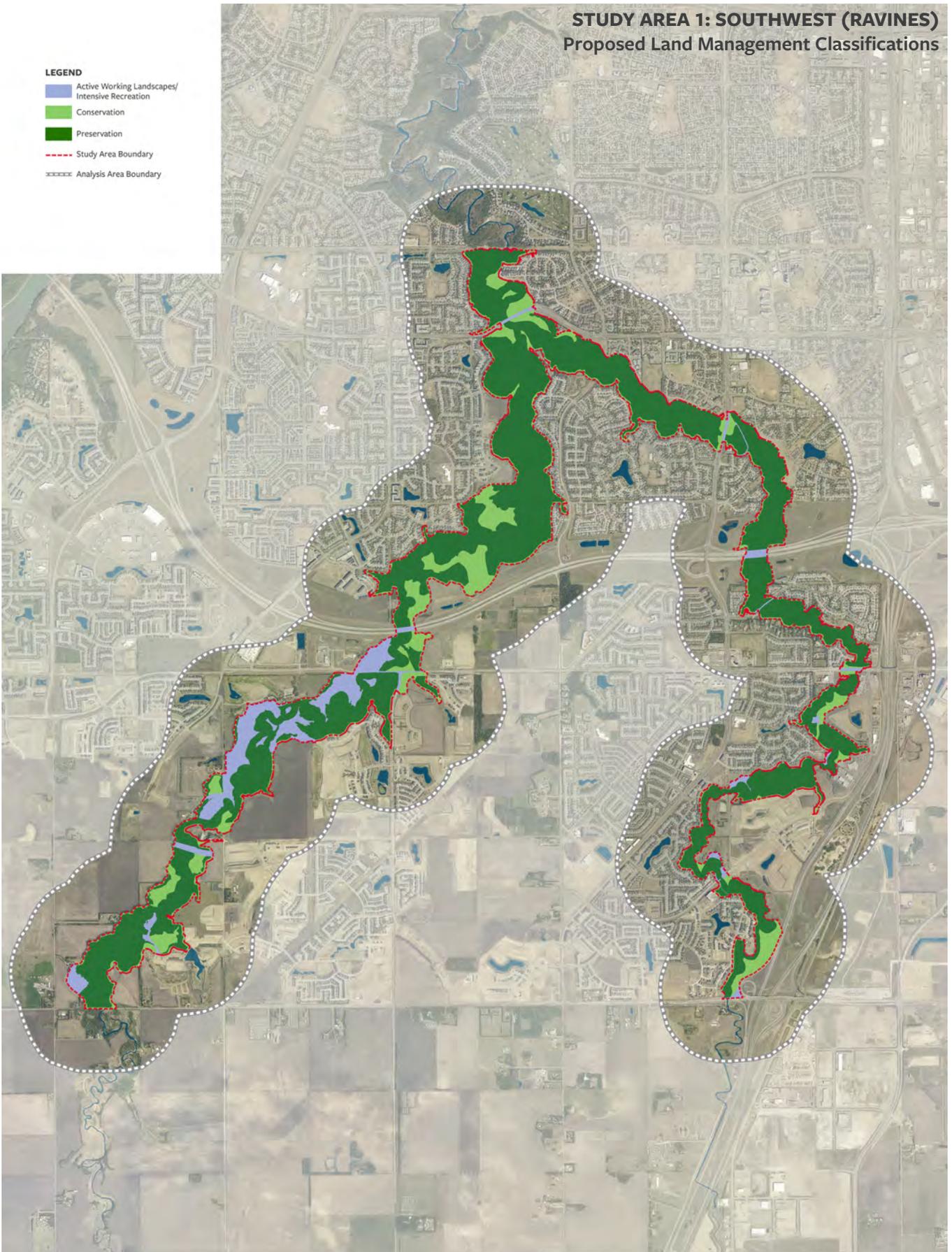


Figure 32. Southwest Management Classification (Ravine)

STUDY AREA 2: NORTHEAST
Proposed Land Management Classifications

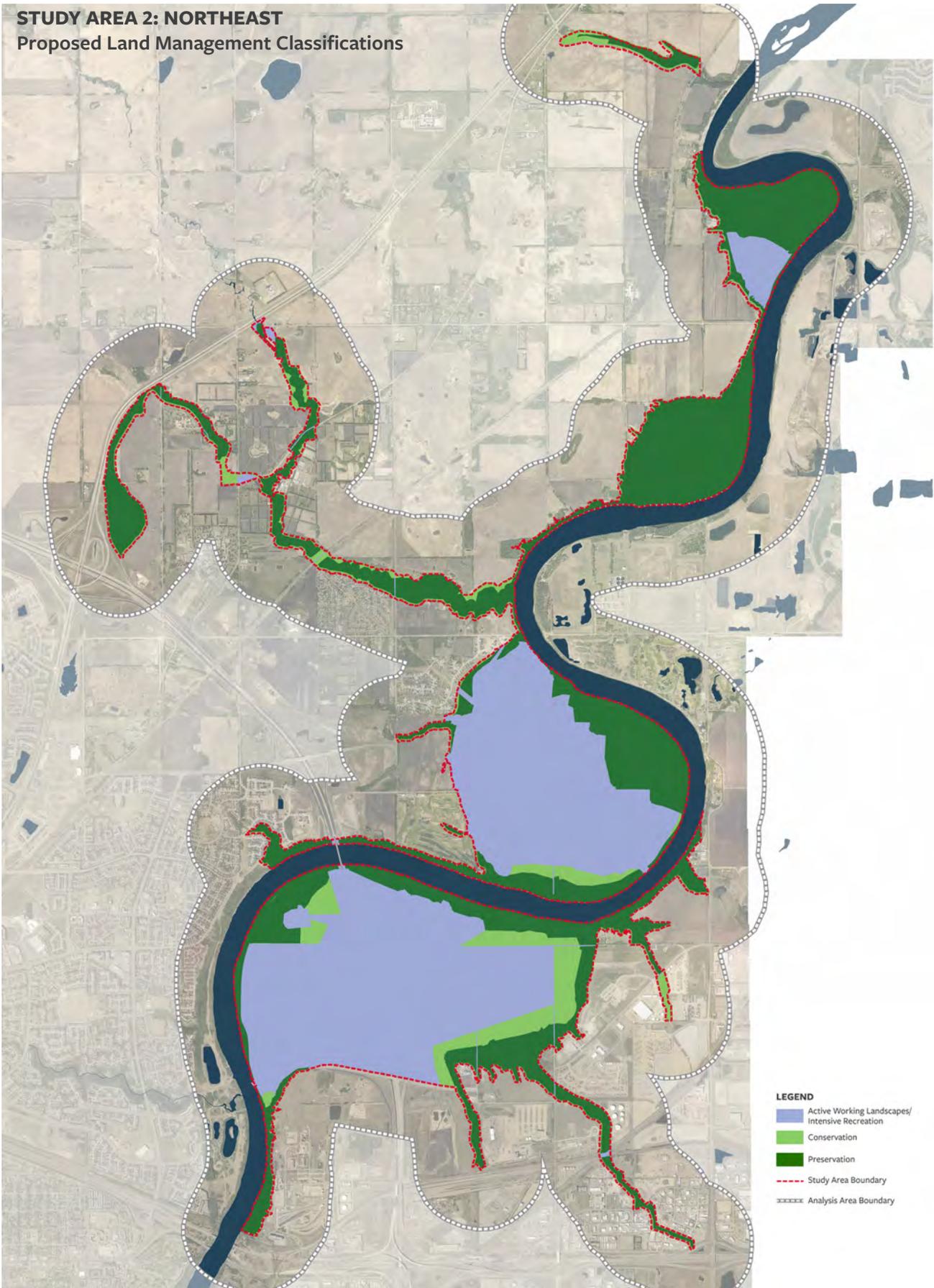


Figure 33. Northeast Management Classification

NEXT STEPS: RESTORATION AND THE RECOMMENDED ECOLOGICAL NETWORK

All of the Land Management Classifications will include areas for restoration. Restoration is a legally and technically specific term for returning a disturbed site to a more or less natural condition (i.e. increasing ecological functionality). Over the last hundred years, industrial, agricultural, recreational and other land uses have altered the ecological functioning in some locations within both study areas. Restoring this functioning while providing appropriate recreational activities will ensure the sustainability and health of the River Valley and Ravine System.

The Ecological Assessment and Land Management Classification process highlighted the areas that currently serve important ecological functions that need to be maintained in the future. It also identified areas where recreational activity is most appropriate. Identifying the locations for restoration is a key part of the next stage in the process and future high-level designs for each amenity node.

This restoration analysis will highlight the following:

- Locations of semi-natural and natural land cover within Preservation and Conservation classifications.
- The intersection of land cover with connectivity pinch points to highlight non-natural areas with high likelihood of wildlife movement, which may require restoration or best management practices (e.g. lighting restrictions and removal of fencing to ensure night time use of the areas).
- Review of areas currently classified as Active/Working Landscapes to flag areas to shift to Conservation and Preservation if the current use no longer exists (e.g. quarries, golf courses etc.).
- Highlight areas surrounding planned amenity nodes or trail head developments, which provide important opportunities for restoration efforts to be combined with development efforts.

These areas for restoration will be combined with the current ecological network (shown on pages 28 to 30) to create the Recommended Ecological Network. This recommended ecological network is a critical first step in the high-level design process for the amenity nodes and trail network that will occur in the next phase of the project.

NEXT STEPS: TRAIL CLASSIFICATION

The Ecological Resources and Historical Resources Overviews both emphasize the sensitivity of the River Valley and Ravine System. The Recreation Assessment, in turn, highlights the desire for more nature-based recreation. This is reinforced through the feedback from the public during Stage 1 where the most frequently shared comments discussed a trail-based recreation network, opportunities to enjoy nature and the importance of protecting the environment.

Process

Once the restoration analysis is complete, a high-level trail network will be drafted to present to the public in the Spring 2018. This draft network will balance the public's desire for more trail experiences while avoiding ecologically and culturally sensitive areas. To do this the network will consider the following:

- Sensitive ecological and cultural areas (landslide areas, sensitive vegetation, areas with high ecological values, rare plants, wildlife habitat, riparian buffers, waterbodies)
- Feedback from the public about connections that they would like to see
- Planned connections as identified in approved Area and Neighbourhood Structure Plans
- Links to surrounding open spaces
- Restoration areas
- Proposed trails, pathways and pedestrian bridges

Land Management Classification Refinement

The balance between recreational access and ecological protection will be achieved through a "Conservation web" approach. Once the draft high-level trail network is defined it will be placed into the "Conservation" Land Management Classification. The result are narrow bands of conservation to protect large areas of preservation.

Future Trail Planning

The maps on pages 49 to 51 show existing trails plus planned top-of-bank trails. They also show trail connections to consider. These trail connections were selected to highlight potential entry points into the system, gaps to fill and the recreational and active transportation network to support. This initial connectivity will be refined during the next project stage.

Trail planning is an iterative approach that will be further refined during subsequent site-specific planning initiatives that occur after approval of the Ribbon of Green (2018) plan. The high-level trail network illustrated in the Ribbon of Green may identify key routes and connections but is not intended to be a comprehensive inventory of all trails proposed for the River Valley and Ravine System. Other trails that develop from and complement this network will be defined during the subsequent site-specific planning initiatives, when detailed on-the-ground assessment and public input can inform the appropriate trail experiences and alignment. It may also be the case that subsequent site-specific planning will realign or remove trail lengths identified in the Ribbon of Green Plan based on field assessment.

STUDY AREA 2: SOUTHWEST
Trail Classification



Figure 34. Southwest Trail Classification

STUDY AREA 1: SOUTHWEST (RAVINES)
Trail Classification

- LEGEND**
- Existing Trails
 - Proposed Top-of-Bank Trails
 - Proposed Trail Connections
 - Analysis Area Boundary

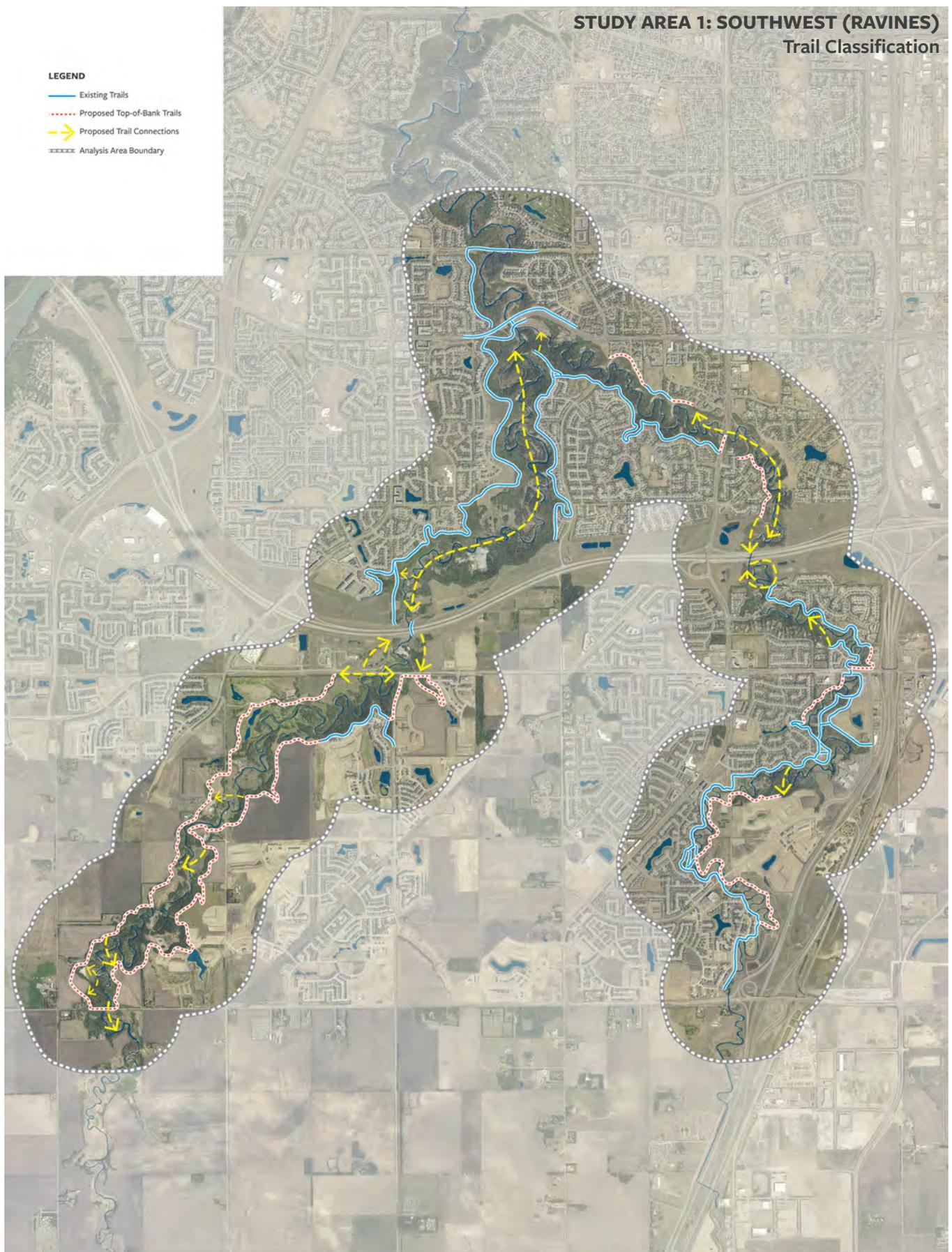


Figure 35. Southwest Trail Classification (Ravine)



Figure 36. Northeast Trail Classification

SPATIAL DATASETS

Input Datasets

NAME	SOURCE	USE/NOTES
Environmental Sensitivity	City of Edmonton - Environmental Sensitivity Project	Land Management Classification definition, trails delineation
Active Slides	Thurber Engineering LTD.	Land Management Classification definition, trails delineation
Historical Sites. Known	Western Heritage	Land Management Classification definition, trails delineation
Transportation Features	Bunt & Associates	Transportation access analysis and map, trails delineation
Historical Sites. Unknown	Western Heritage	Land Management Classification definition, trails delineation
Recreational Features	RC Strategies	Recreation Assessment and maps, trails delineation
Aerial Imagery 2016	City of Edmonton	Base map, data proofing and digitizing, trails delineation
Aerial Imagery 2014	City of Edmonton	base map, data proofing and digitizing, trails delineation
Full Feature Lidar	City of Edmonton	Digital Elevation Model - Bare Earth, Digital Surface Model - All Object on Ground, contours
Open Spaces	City of Edmonton - Breathe Project	Base map, trails delineation
Land Cover	City of Edmonton - Breathe Project	Land Management Classification definition, trails delineation
North Saskatchewan River Valley and Ravine System	City of Edmonton	Land Management Classification definition, trails delineation, used as a base of study area
Wildlife connectivity	City of Edmonton - Breathe Project	Land Management Classification definition, trails delineation
Bridges\River Crossings	City of Edmonton - Breathe Project	Recreation maps, trails delineation
Bike Routes	City of Edmonton - Breathe Project	Recreation maps, trails delineation
Bus Stops	City of Edmonton	Context layers, trails delineation
Recreational Facilities	City of Edmonton - Recreational Facilities	Context layers, trails delineation
Flood Fringe	River Forecast Section, Alberta Environment and Parks, Government of Alberta	Flood analysis map, trails delineation
Flood Way	River Forecast Section, Alberta Environment and Parks, Government of Alberta	Flood analysis map, trails delineation

Derived Datasets

NAME	SOURCE	USE/NOTES
NE and SW Study Area Boundaries	Digitization based on DEM, Rivers and Creeks and Aerial Photo Interpretation	Area to define final Land Management Classifications
NW and SW Analysis Area Boundaries	600m buffer around NE and SW Study Areas	Most of datasets used for analysis are clipped by this extent
Land Management Classifications	Derived from data inputs, and modified to account for existing and planned land uses. Described in greater detail in this report.	Define management plans
Viewsheds from River	Viewshed analysis from observers on the river placed every 100m	River viewsheds, (how much natural area could be seen from the river view points)
Contours	Contours tool from ArcGIS	Trails delineation
Digital Elevation Model - Bare Earth	LASTools was used to create raster DEM dataset as the last return from LiDAR	Base map, Trails delineation, Ravines and River Valley delineation, Land Management Classifications Definition
Digital Surface Model - All Objects	LASTools was used to create raster DEM dataset as the last return from LiDAR	Viewsheds
Terrain Ruggedness Index	QGIS TRI Tool	Terrain Ruggedness Map, Ravines and River Valley delineation

