

Supplementary file S2
Table of strategies and criteria

List of abbreviations

- DOC: Denominazione di Origine Controllata (controlled designation of origin) – Italian geographical indication for wines
- DOCG: Denominazione di Origine Controllata e Garantita (controlled and guaranteed designation of origin) – Italian geographical indication for wines
- LULC: Land Use/Land Cover
- MAV: Media and Alta Valtellina
- PDO: Protected Designation of Origin – European geographical indication for food products
- REN: Regional Ecological Network
- RGI: Regional Green Infrastructure
- RLP: Regional Landscape Plan
- RTAP: Regional Territorial Area Plan

Key topics	Thematic objectives	Strategic priority areas	Spatial data and sources	Selection and representation criteria	Design solutions
KT1_Identity	KT1a_Preserving unity and perceivability of hydro-geo-morphological elements	Glaciers to be supervised and protected in order to tackle climate change impacts	Regional LULC map	Representation of glaciers	_Placement of geotextile sheets
		Priority areas to tackle structural modifications and prevent risks on hydrographic network: 1. areas to safeguard of the river morphology and increase of the naturalistic values; 2. areas to prevent hydrological risk prevention and increase naturalistic values in urbanized context; 3. priority areas to prevent hydrological risk on minor hydrographic network	Regional LULC map; Hydrographic network; National map of hydrological instability areas	Intersection between high hydrogeological instability areas and land uses; diversification of actions according to land uses and hydrological classification	_Maintenance of riparian areas with cleaning or replacement of decayed plants _Increase of riparian vegetation to slow down runoff _Reinstatement of flood plains by moving embankments back or reshaping river banks _Supervised flooding of rural areas next to river banks _Reactivation of river dynamics through removal of embankments or expansion of riverbeds _Reshaping and restoration of the natural course of rivers and streams _Desealing of urban soils _Creation of retention basins _Delocalization of buildings and infrastructures located next to rivers _Riverine wood maintenance with supervised cutting _Increase of morphological diversity of riverbeds
		Priority areas to prevent hydrogeological risk on mountain woodlands	Regional LULC map; National map of landslide hazard	Selection of mountain woodlands exposed to high or very high landslide hazard	_Changes in woodland management _Prevention and control of soil erosion through renaturalization, grassing or stabilization of hydrographic network _Wildfires prevention (e.g. bushes and fire break paths maintenance)
		Peculiar hydro-geo-morphological features to be preserved	Regional geological heritage sites (geosites)	Punctual representation of geosite locations	_Census and supervision of peculiar geological features _Creation and maintenance of trails and paths
		High visibility mountain landscapes to be preserved	Digital Terrain Model with 5 m resolution; Panoramic viewpoints of regional, provincial or local relevance; Adda river Greenway; panoramic paths and routes; Photographic density hotspot from InVEST - Recreation model	Viewsheds derived from viewpoint sources; selection of high visibility areas based on Natural Breaks classification of raster values; vectorialization and merging of selected areas	_Preservation of viewpoints through limitations to building heights and rules for signage and billboards placement _Limitation and mitigation of planned interventions which may alter the aspect of slopes _Interventions for the improvement of panoramic paths and viewpoints
		KT1b_Preserving landscape values of natural elements	Priority areas to tackle vegetation diversity loss	Regional LULC map; Forestry management plan for Alta Valtellina	Selection of woodlands belonging to higher classes of vegetation diversity according to the Forestry management plan
	KT1c_Preserving constitutive features of rural landscape	Traditional and historical rural landscapes to be maintained, preserved and enhanced	Regional and provincial LULC maps; map of terraced areas; RGI	Selection of rural and terraced areas within RGI cultural and historical multifunction reinforcement areas	_Maintenance and preservation of dry stone walls in terraced areas and historical rural buildings _Maintenance and recovery of meadows on valley floors (e.g. trimming of abandoned meadows, introduction of flower species) _Maintenance and recovery of grassland and orchards (e.g. introduction of quality species, selective thinnings)
		Priority areas where to tackle forest regrowth	Regional LULC maps	Detection of 1999-2018 land use change from stable meadows to woodlands; selection of meadows endangered by proximity to wood advance; simplified representation of high risk areas	_Arrangement of pasture management plans to preserve pastures _Supervised trimming and deforestation interventions in endangered areas _Sustainable mowing in permanent meadows on valley floors
		Priority areas where to tackle abandon and degradation of croplands	Regional LULC maps	Detection of 1999-2018 land use change from crop rotation areas to meadows or shrubland; simplified representation of detected areas	_Census and management of abandoned land through farmland banks _Adoption of conservation agriculture methods to recover degraded soils
		Alpine rural buildings to be restored, enhanced or preserved	Mountain huts	Representation of mountain huts	_Multi-functional enhancement of active huts (e.g. creation or empowerment of pedestrian trails, connections with valley floors, management of water resources) _Multi-functional enhancement of abandoned or underused huts (e.g. refurbishment and reuse as mountain shelters) Preservation and renovation of huts in accordance with traditional shapes and materials _Preservation and _Preservation and restoration of the surroundings of mountain huts (paths, stone walls, water streams, pits...) _Startup of policies to promote typical mountain products based on pastures and huts
	KT1d_Preserving the features representing the identity of the anthropic landscape	Valley floor historical urban settlements to be restored, enhanced or preserved	Historical urban settlements	Selection of historical urban settlements located on valley floors	_Recovery and reuse of building heritage preserving traditional building types and materials _Redevelopment of public spaces system (streets, squares...) to promote pedestrian usage and tourism _Connections between urban settlements and open spaces (access to waterways, links with mountain paths) _Vacant retail stores mapping and incentives to temporary reuse of vacant spaces) _Improvement of connections with the main recreational paths (e.g. Adda Greenway) with the creation of areas equipped to host activities for visitors and territorial promotion _Improvement of public transport networks
		Slope historical urban settlements to be restored, enhanced or preserved	Historical urban settlements	Selection of historical urban settlements located on slopes	_Recovery and reuse of building heritage (including reuse as scattered hotels or agritourism) preserving traditional building types and materials _Preservation and reinforcement of the connections with valley floors (e.g. road maintenance, improvement of public transport, enhancement of paths _Promotion of trails connecting historical villages with cultural heritage sites along mountain slopes _Economic policies in support of local productions and landscape promotion _Startup of open-air cultural events and exhibitions along historical settlements and their surroundings _Improvement of digital telecommunication networks

	Historical and cultural heritage sites to be preserved	Historical and cultural heritage sites	Representation of historical and cultural heritage sites as points	<ul style="list-style-type: none"> _Creation of widespread thematic trails, involving interventions on public spaces and signage systems _Cultural enhancement of historical industrial sites, power plants or mines
	Historical and cultural heritage clusters to be preserved	Historical and cultural heritage sites	Representation of historical and cultural heritage high density units, as points	<ul style="list-style-type: none"> _Reinforcement of cycle paths and tracks and of their connections with Adda Greenway
	Aggregations of buildings and areas with significant landscape quality (RLP Discipline, Art. 23)	RLP	Same representation as RLP	<ul style="list-style-type: none"> _Detailed recommendation and actions reported in the Aggregations sheets of the RLP
	UNESCO World Heritage Sites (RLP Discipline, Art. 37)	RLP	Same representation as RLP	<ul style="list-style-type: none"> _Creation of networks to connect UNESCO sites with the surrounding local heritage system

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KT2_Natural Capital	KT2a_Promoting maintenance, reinforcement or reinstatement of ecological connectivity and high habitat quality	Regional Ecological Network (REN) primary corridors	REN	REN primary corridors	<ul style="list-style-type: none"> _Improvement of ecological connections through reforestation and reinstatement of shrubs _Creation of wildlife crossings to overstep infrastructures _Increase of ecological values in rural areas through conservation agriculture systems _Maintenance of riparian areas with cleaning or replacement of decayed plants
		REN passages	REN	REN passages	<ul style="list-style-type: none"> _Creation of tree rows on and green buffer zones on urban edges _Greening interventions on permeable areas _Creation of green bridges and wildlife crossings to overstep infrastructures
Landscape enhancement connections from RGI with mainly environmental purposes		RGI	Selection of landscape enhancement connections from RGI with mainly environmental purposes	<ul style="list-style-type: none"> _Riparian vegetation maintenance and renovation with cleaning or replacement of decayed plants _Reinstatement and increase of riparian vegetation with tree rows and shrubs _Reinstatement of flood plains by moving embankments back or reshaping river banks _Preservation and recovery of croplands, where possible with conservation agriculture systems 	
Priority revitalization areas for damaged woodland ecosystems:		Regional LULC map; map of woods damaged by windstorms and beetle outbreaks; map of wildfire ignition points from regional wildfire prevention plan	classification of damaged woodlands by damage cause; representation with point symbols		<ul style="list-style-type: none"> _Definition of priority criteria to reinstate vegetation, depending on the main function of damaged woodlands _Creation of temporary structures to prevent rockfalls and hydrogeological instability _Interventions to protect newly planted trees from attacks by wildlife _Diversification of species chosen for reforestation, in order to reduce vulnerability _Recovery of damaged woodland management infrastructures and pastures
KT2b_Promoting reorganization and defragmentation of peri-urban landscapes tackling loss of biodiversity	1. revitalization areas of woodland ecosystem damaged by windstorms;	2. revitalization areas of woodland ecosystem damaged by wildfires;	3. revitalization areas of woodland ecosystem damaged by beetle outbreaks		<ul style="list-style-type: none"> _Seeding of local herbaceous plants to prevent the removal of fertilizing ashes caused by runoff _Safeguard of slopes with temporary canal systems _Cutting of partially burnt plants with extensive damages _Concealment of areas hit by fire with wooded buffer zones _Reforestation by site-specific and suitable wood species, in accordance to the main functions of lost woodlands _Recovery of damaged woodland management infrastructures and pastures
					<ul style="list-style-type: none"> _Supervision of the infestation through traps and satellite images _Supervised cutting of infested plants, prioritizing woodlands with a protection function _Stabilization of involved slopes with light soil bioengineering methods _Pest control with the use of bait to attract the insects _Arrangement of monitoring and early warning systems in case of fall of infested plants
	Peri-urban rural areas to be preserved:	Regional LULC map; Regional map of mobility infrastructures; RGI	Detection of peri-urban rural areas with significant risk of encirclement by urbanized areas and infrastructures (more than half of their perimeter is encircled); Selection of risk areas within RGI; classification by environmental, historical and cultural values		<ul style="list-style-type: none"> _Creation of allotments with local vegetation species _Introduction of rural products in local supply chains _Increase of natural values by planting new scrub and bushes _Creation of green bridges and wildlife crossings to overstep infrastructures _Creation of green buffer zones next to settlements and infrastructures
	1. areas with high environmental values;	2. areas with high historical and cultural values;	3. areas with high environmental, historical and cultural values		<ul style="list-style-type: none"> _Creation of public green areas and pocket parks, enhancing cycle and pedestrian accessibility _Creation of green buffer zones next to settlements and infrastructures _Reuse of near buildings as low-impact facilities in support to recreation _Introduction of rural products in local supply chains _Creation of green bridges and wildlife crossings to overstep infrastructures
					<ul style="list-style-type: none"> _Actions refer to both previous categories

	Priority areas where to tackle linear conurbation trends	Regional LULC maps	Linear conurbation trends detected from analysis of land use changes between 1999 and 2018	<ul style="list-style-type: none"> _Green buffer zones and tree rows on urban edges _Greening leftover permeable spaces with a variety of local plant species _Adoption of planning strategies aiming at reduce urban sprawl and preserve rural land _Creation of integrated green buffer zones on new urban projects _Incentives to the reuse of abandoned structures to tackle land take
KT2c_Limiting, containing and mitigating impacts of anthropic activities	Areas involved in mining activities whose impacts should be limited and mitigated	Provincial quarries management plan; RGI	Selection of mining areas next to RGI	<ul style="list-style-type: none"> _Mitigation of visual impact through wooded buffer zones _Mitigation of acoustic impact with noise barriers _Use of constructed wetlands or aerated lagoons for wastewater treatment _Diversification of quarries recovery depending on the morphology and slope of quarries _Renaturalization of exhausted quarries with local plant species _Rural reuse of exhausted quarries with suitable crops _Creation of quarry lakes with local habitats
	Hydroelectric power plants and electrical power lines whose impacts should be limited and mitigated	Provincial LULC map	Representation of hydroelectric power plants and electrical power lines	<ul style="list-style-type: none"> _Mitigation of visual impact through wooded buffer zones _Mitigation of acoustic impact with noise barriers _Refurbishment with suitable colours and materials _Where it is possible, placement of underground power lines in high quality landscapes _Appropriate placement of transmission towers in relation to major visual axes _Placement of bird deterrents on wires
	Industrial or commercial settlements and accommodation facilities whose landscape and environmental suitability should be increased	Regional LULC map; RGI	Industrial or commercial settlements and accommodation facilities next to RGI whose area is greater than 50.000 sqm	<ul style="list-style-type: none"> _Mitigation of visual impact through wooded buffer zones _Increase of environmental quality through greening of open spaces and reduction of impervious pavings _Increase of permeability through permeable paving, green roofs and green walls _Increase of energy efficiency through solar power or passive solutions _Refurbishment with suitable colours and materials
	Ski resorts to be involved in integrated redevelopment strategies	RTAP MAV	Representation of ski resorts to be involved in integrated redevelopment strategies according to RTAP MAV	<ul style="list-style-type: none"> _Recognition of areas for nordic skiing _Promotion of sustainable complementary activities (unpaved tracks, heliskiing, snowcats) _Seasonal interventions to promote the use of pistes during spring and summer _Safeguard of tracks with light bioengineering methods
	Landscape mitigation and integration buffers for new infrastructures from RGI	RGI	Landscape mitigation and integration buffers for new infrastructures from RGI	<ul style="list-style-type: none"> _Creation of buffer tree rows _Reduction of noise pollution through noise barriers next to urban areas _Creation of compatible croplands along edges and curves _Design of high quality bridges and viaducts _Design and management of intersections with cycle and pedestrian paths _Creation of green bridges and wildlife crossings

Key topics	Thematic objectives	Strategic priority areas	Spatial data and sources	Selection and representation criteria	Design solutions
KT3_Sustainable Recreation	KT3a_Promoting sustainable recreation in natural heritage, also through soft mobility networks and landscape connections	Local trail network sections to be improved and enhanced	Map of regional trail network; hiking circuits from RTAP MAV	Selection of trail sections included in supra- local hiking circuits planned by RTAP MAV	<ul style="list-style-type: none"> _Maintenance and securing interventions for paths _Preservation of viewpoints and outlooks through land use restrictions, signage and billboard control _Reuse and refurbishment of abandoned structures along paths for recreational purposes _Connections with the Adda Greenway and with public transport stops _Creation of a corporate visual identity for signage
		Landscape enhancement connections from RGI with mainly recreational purposes	RGI	Selection of landscape enhancement connections from RGI with mainly environmental purposes	<ul style="list-style-type: none"> _Maintenance and reinforcement of path continuity _Safeguard and enhancement of panoramic viewpoints through land use restrictions and signage control
		Landscape connection projects from RGI with mainly recreational purposes	RGI	Selection of landscape enhancement connections from RGI with mainly recreational purposes	<ul style="list-style-type: none"> _Maintenance and reinforcement of path continuity _Safeguard and enhancement of panoramic viewpoints through land use restrictions, signage and billboard control
		Sustainable recreational enhancement of "Landscapes of Silence"	RTAP MAV	"Landscapes of Silence", established by RTAP MAV as highly natural areas to be involved in sustainable tourism development	<ul style="list-style-type: none"> _Maintenance and reinforcement of hiking trails _Integration of huts, shelters, agritourisms in recreation networks _Restoration or maintenance of architectural heritage
		Environmental systems to be enhanced, redeveloped and restored	RTAP MAV	Representation of landscape enhancement, redevelopment and restoration areas from RTAP MAV with primarily environmental features	<ul style="list-style-type: none"> _Creation and improvement of trails connecting natural systems _Reinstatement of the natural course of the Adda river and environmental recovery in val Pola, damaged by a landslide _Enhancement of trails, huts, shelters in areas to qualify as Silence landscapes _Interventions on healthcare complexes to be restored and renovated (Morelli sanatorium, in the town of Sondalo), with recreational enhancement of surrounding open spaces and connections with the Adda Greenway
	KT3b_Supporting traditional and quality supply chains in farming, forestry and dairy products as multifunctional activities	Priority multi-function enhancement areas: mountain pastures	Map of mountain pastures; RGI	Selection of mountain pastures within RGI	<ul style="list-style-type: none"> _Improvement of cycle and pedestrian paths which pass through pastures _Supervised trimming and deforestation interventions in pastures endangered by forest regrowth _Integration of huts and pastures in promotion networks for local dairy productions
		Priority multi-function enhancement areas: wine production	DOC and DOCG wine production zones	Representation of DOC and DOCG wine production zones in the study area	<ul style="list-style-type: none"> _Incentives to vineyard development rather than other land uses _Settlements with private owners to promote accessibility of rural paths _Maintenance and enhancement interventions for terraced landscapes _Territorial promotion of local wine companies, also through public events
		Priority multi-function enhancement areas: typical dairy production	Map of production sites of PDO local cheeses	Representation of mountain huts where PDO cheeses are officially produced	<ul style="list-style-type: none"> _Integration of local productions in tourist supply chains _Usage of local productions in short supply chains _Development of focused marketing strategies _Recreational and educational uses for huts involved in dairy production

	Priority multi-function enhancement areas: apple orchards	Regional LULC map	Simplified representation of apple orchards, where PGI apple varieties are produced	<ul style="list-style-type: none"> _Incentives to vineyard development rather than other land uses _Settlements with private owners to promote accessibility of rural paths _Integration of local productions in tourist supply chains _Usage of local productions in short supply chains
	Priority multi-function enhancement areas: historical cereal production	Historical and tourist local maps	Representation of the "Mill Valley", the historical core of cereal production in the study area	<ul style="list-style-type: none"> _Incentives to restoration and opening of mills _Promotion of educational events on site concerning historical local cereal production
KT3c_Promoting and enhancing recreation in historical and cultural heritage	Structural soft mobility elements whose connections with local cycle path network should be increased	RTAP MAV	Adda river Greenway, established from RTAP MAV	<ul style="list-style-type: none"> _Creation of permeable junctions between Adda Greenway and local paths _Prioritizing connections to enhance accessibility to environmental and heritage systems _Separation between cycle and pedestrian crossings along crossroads _Startup of bike sharing systems and intermodal connections in urban areas _Creation of a corporate visual identity for signage
	Historical and cultural systems to be enhanced, redeveloped and restored	RTAP MAV	Representation of landscape enhancement, redevelopment and restoration areas from RTAP with primarily historical and cultural features	<ul style="list-style-type: none"> _Creation of connection trails between cultural heritage systems _Linking trails with the Adda Greenway _Promotion of focused strategies for opening private heritage assets to the public _Financial incentives to restoration and maintenance of private assets _Creation of a corporate visual identity for signage _Promotion of educational events and activities for students
KT3d_Exploring and promoting alternative tourism and recreation	Attention and mitigation areas linked to possible functionality loss of low altitude ski resorts	RTAP MAV; Digital Terrain Model with 5 m resolution	Selection of ski resorts and cross-country tracks more than 40% of whose area is located below 1650 m	<ul style="list-style-type: none"> _Conversion to integrate recreational activities (MTB, snowshoes, hiking trails...) _Renaturalization and recreational enhancement of pistes _Creation of tanks and basins to improve management of water resources used for snowmaking _Implementation of integrate weather databases to monitor multi-year variations in snowing
	Attention and mitigation areas linked to overtourism impacts	Statistical data on tourism	Punctual symbols on municipalities affected by significant overtourism impacts	<ul style="list-style-type: none"> _Good practices for energy efficiency of accommodation facilities (e.g. use of solar power and bioenergy) _Sustainable refurbishment of mountain shelters with improvement of energy efficiency _Promotion of alternative winter activities (MTB, snowshoes, hiking trails...) _Promotion of tourism and recreational events outside winter season (e.g. food and wine or wellness tourism) _Multi-scale planning for public transport, including transfers to ski resorts
	Areas substantially depending on winter tourism	Statistical data on tourism	Punctual symbols on municipalities considerably depending on winter tourism activities	<ul style="list-style-type: none"> _Conversion to integrate recreational activities (MTB, snowshoes, hiking trails...) _Renaturalization of abandoned or underused pistes and surrounding spaces _Promotion of tourism and recreational events outside winter season (e.g. food and wine or wellness tourism)