

Landscape Architecture and Site Planning of Green Campus Faculty of Agriculture and Natural Resources Rajamangala University of Technology Tawan-Ok, Bo Thong District, Chonburi Province

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Abstract

This research is an extension of the study on “Geographic Information in Analyzing the Site Potential for Planning the Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan-Ok, Bo Thong District, Chonburi Province.” The main objective is to design landscape architecture of Bo Thong institution as a Green Campus, utilizing experimental results, discussion outcomes, and overall recommendations. Additionally, it involves synthesizing the area to design a schematic layout and creating appropriate alternative or detail designs and construction for future development.

The analysis of developing the 660 Rai Bo Thong Institute in the hilly plain area with abundant water resources, dense communities, and accessibility to roads, infrastructure and communication, allows for the classification of three zones: 1. Public Zone, 2. Semi-public Zone serving as an educational and service center, and 3. Private zone include recreational and residential Zone. Furthermore, the usable areas are divided into eight zones, with two additional connecting points. These designs propose a green educational institution (Green campus) with ten areas known as Zones A-J, including 1) Academic Area, 2) Administrative Building Area, 3) Staff Residence -Dormitory Area, 4) Commercial Area, 5) Sports and Recreational Area, 6) Conservation Area, 7) Agriculture Area, 8) Service and Maintenance Area, 9) Plaza/Landmark Area, and 10) Green Walkway.

Summarizing the analysis of requirements, attitudes, university image, and the green university (Green campus) concept, the proposed educational institution layout for Bo Thong can be summarized as follows: 1) Space improvement planning, 2) Community involvement, 3) Development of renewable energy utilization, 4) Reduction of wasteful resource usage, reuse, and recycling, 5) Knowledge development for the community, 6) Landscape development for tourism, 7) Resource management, disaster prevention, and mitigation through creative development. The crucial aspects to consider for the green institution (Green campus) are energy and climate change, infrastructure planning, transportation, waste management, research, and water resources.

Regarding the design and layout, there are two options presented for utilizing the land in the green campus: 1. Using the existing roads as main thoroughfares, and 2. Using the existing roads as green walkways (Green Way) and moving the road north of the project.

Keywords : Green Campus, Land use zoning, Site Planning, Zoning design

1. Introduction

The Policy and Strategy for Higher Education, Science, Research, and Innovation for the years 2020-2027 provides a framework for the development of the education, science, research, and innovation system in Thailand in line with the direction of the national strategy, master plans, and government policies. Its vision is to “prepare Thai people for the 21st century, develop an inclusive economy, a stable society, and a sustainable environment, while fostering cutting-edge innovation internationally and leading the country towards developed status.” The development objectives include: 1) developing human resources and institutions of knowledge, 2) conducting research and creating innovations to address societal challenges, 3) promoting research, innovation, and entrepreneurship, and 4) developing the capacity and reducing disparities through spatial development.

This policy is implemented in conjunction with the reform of the higher education, science, research, and innovation system of the country, which currently lacks a sufficient large-scale infrastructure to support future research. Developing research infrastructure is essential to support investment in creating and developing foundational structures on a broad scale, capable of accommodating advanced global research. It is important to strive for excellence, enhance competitiveness, promote sustainable economic prosperity, and foster collaboration both domestically and internationally. The reform of the higher education, science, research, and innovation system aims to propel Thailand towards full and sustainable development by reforming university management systems, designing management systems, policies, strategies, and plans. It includes the design of funding allocation and budget management systems, result tracking systems, and data integration systems. It also focuses on the development of convenient facilities for higher education institutions, state research institutes, and the industrial sector. Additionally, it emphasizes the development of highly skilled human resources to support the special economic zones in the Eastern Economic Corridor (EEC) region through curriculum alignment and collaborative research between educational institutions and businesses in the EEC area.

The Rajamangala University of Technology Tawan-Ok, Bang Phra Campus, is an educational institution that provides higher education in various academic and professional fields, offering certifications, diplomas, and degrees, including bachelor’s, master’s, and doctoral degrees. It also engages in research and provides academic services to society. The Faculty of Agriculture and Natural Resources is one of the faculties under its administration. It aims to develop the mentioned area into a new educational precinct called Bo Thong Campus, managed by the Faculty. The plan involves enhancing the efficiency of the existing space, promoting and participating in community development, implementing integrated farming practices, promoting self-sufficiency, creating beautiful environments and landscapes, and managing university resources effectively.

The analysis leading to the design of the educational precinct covers an area of approximately 660 Rai. The current state of the area is described as abandoned and encroached upon by local residents. Therefore, the Faculty of Agriculture and Natural Resources of Rajamangala University of Technology Tawan-Ok, Bang Phra Campus, aims to develop the area into Bo Thong Campus by maximizing the efficiency of the existing space for educational institutions, promoting and

participating in community development, improving the area for recreational activities, tourism, and sports, creating beautiful environments and landscapes, and ensuring the quality of life by managing university resources, planning for natural disaster prevention and mitigation, and designing appropriate physical space utilization.

To achieve these objectives, a master plan has been designed to align with the context of the educational precinct and the goals set forth in the national higher education, science, research, and innovation policy. The plan encompasses the utilization of resources, energy efficiency, waste management, green transportation, and the establishment of a green educational institution. It also includes the design of a comprehensive plan that takes into account the existing landscape, cultural heritage, and community needs. The plan aims to integrate the educational precinct with the surrounding area and promote sustainable development, green spaces, and the conservation

2. Research method

The study focuses on the development of a creative urban planning framework using integrated analysis and geographic information system (GIS) data in the study area of Bo Thong Institute in Chonburi province, which covers 660 acres of land. The study is conducted by the Faculty of Agriculture and Natural Resources, Rajamangala University of Technology Tawan-Ok, located in the hilly area with a large water source in Bo Thong District, Chonburi Province. Additionally, the study includes conducting surveys of important surrounding areas. The research methodology employed in this study involves the following steps:

The study examines the research findings and summarizes the data obtained from the Geographic Information System (GIS) and Remote Sensing (RS) through high-resolution satellite imagery. The analysis includes physical factors such as land use, geology, hydrology, topography, soil types, vegetation, temperature, as well as the results and conclusions derived from interviews and questionnaires, which are human-created factors. These factors encompass transportation routes, public utilities, public services, history, society, culture, and the conclusions derived from factors related to aesthetics, including visual quality and the character of open spaces, natural landscapes, and in-depth interviews with three key representative groups: 1) Local administrators: District Chief, Tambon Administrative Organization Representatives, and Community Representatives; 2) Faculty of Agriculture administrators and department heads: Dean and Department Head; and 3) Experts in university planning and design and experts in institution design or academics who have experience in designing green institutions. The purpose is to apply the data and classify the land use requirements in each zone of the entire 660 Rai area.

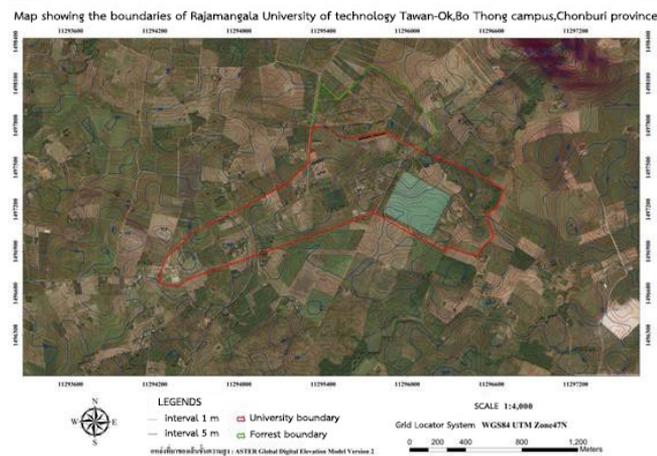
Based on the analysis of topographic data from theoretical frameworks and literature reviews of each factor, including natural factors, human-made factors, and aesthetics from planning experts, including both academic and experienced professionals, the synthesis results in a summary of the proposed educational institution layout guidelines for Bo Thong, Chonburi Province. The guidelines divide the area into 10 usable zones. Subsequently, these 10 zones are used to explore two alternative layout options, which are based on the research findings and discussion results. These

options then lead to recommendations for the design and layout of the green educational institution in Bo Thong, Chonburi Province, in this study.

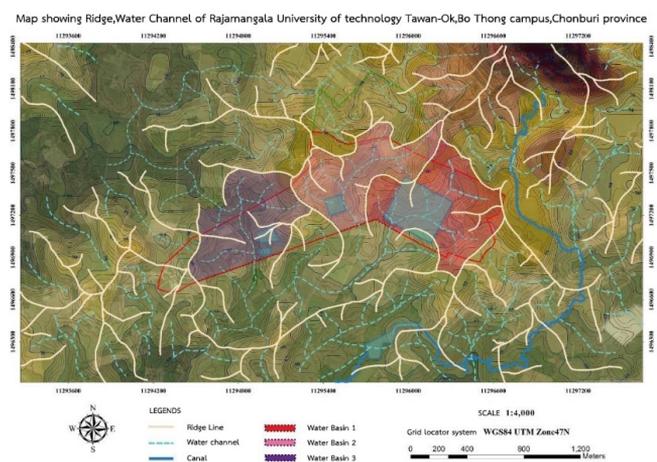
3. Results and Discussion

The analysis of physical and spatial factors of the educational zone in Bo Thong, which spans an area of 660 Rai, reveals the following:

The development of Bo Thong as an educational institution zone is a suitable option for utilizing this vacant land. The location, situated in a hilly area with a large water source, offers favorable conditions for the establishment of an educational institution that aligns with the changing land use patterns in the Eastern Economic Corridor, as depicted in Pictures 1 and 2.



Picture 1 Boundaries and contour lines of Bo Thong Campus



Picture 2 Physical potential: contour lines, waterways and ridges

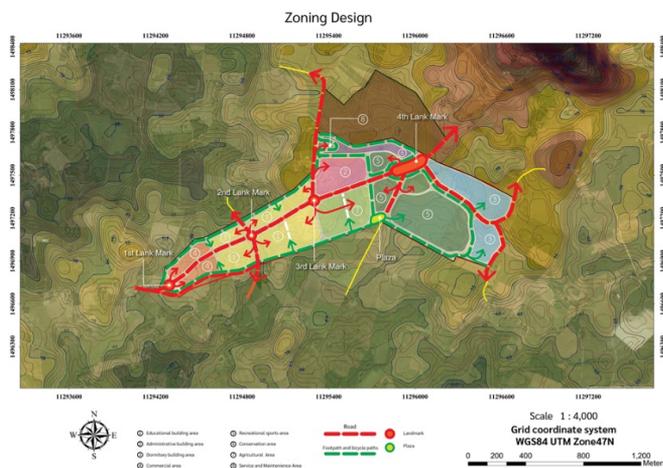
The analysis of spatial accessibility and the prioritization of areas for foundational development and spatial layout of the educational institution zone in Bo Thong focuses on the physical aspect and the perspective that encompasses both the external and internal architectural forms. It also involves organizing the land use or establishing static zoning based on the physical characteristics studied and analyzed in Pictures 3, 4.

5) Zone E: This zone is similar to Zone 4. 6) Zone F: This zone has characteristics similar to Zones 1 and 4 but is located on the northern side adjacent to forest and mountain areas. It has water sources and a view towards the east/north direction. 7) Zone G: This zone is similar to Zone 6 but has a southern entrance. It is centrally located in the area, intersecting with two main roads. 8) Zone H: This zone is similar to Zone 6 but has good accessibility from both the north and south entrances. It has a rectangular shape and a large water source as a primary component. 9) Zone I: This zone is similar to the aforementioned zones, but accessibility is available from the southern road and the eastern/northern border. It has adjacent water sources in the southeast direction and a view of large bodies of water and hills in the north direction. The main road exits towards the east/north direction. 10) Zone J: This zone is similar to the aforementioned zones but has the most difficult accessibility from the main entrance compared to other areas. It has a wide-angle view of the water bodies in the west direction and forest/mountain ranges in the north direction. The vegetation is minimal, and it is an extensive area almost in the shape of a rectangle. The main road passes through the northern direction and is located near the water bodies in the east direction. It serves as a connection point with the external area and has a view from the east direction. Refer to Pictures 1-4 for details.

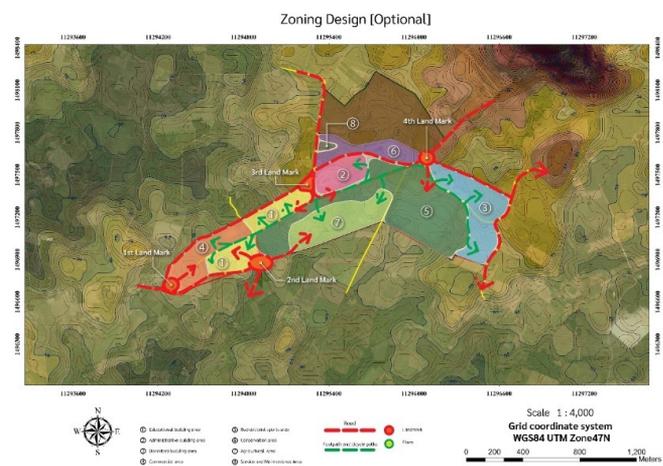
Table 1 The scores and their relationship with function program

	A	B	C	D	E	F	G	H	I	J	
Natural Factor	3	3	3	3	3	3	3	3	3	3	Characteristic of soil/rock
	3	3	2	3	3	3	3	3	3	3	Land form
	3	3	2	3	3	3	3	3	3	3	Altitude
	3	3	2	3	3	3	3	3	3	3	slope
	3	3	2	3	3	3	3	3	3	3	slope
	4	3	5	4	4	4	4	4	3	3	Water intake - drainage
	4	4	5	5	4	4	4	2	2	2	Surface water
	2	3	2	2	2	2	2	2	2	2	Native animals
	3	3	3	3	4	4	3	3	4	3	Wind speed and direction
	4	4	4	4	3	3	3	3	3	3	Microcirculation temperature
Man Made factor	3	3	3	3	3	3	4	4	4	4	transportation route
	3	3	2	3	3	5	3	3	2	2	Buildings
	3	3	3	4	3	4	3	3	3	3	Utilization of the existing area
	3	3	3	3	3	3	3	3	3	3	Law
	3	3	3	4	3	4	4	4	4	4	public Utilities
	3	3	3	3	3	3	2	2	2	2	Cultural significance
Aesthetic factor	4	4	3	2	3	2	3	3	4	4	Site Approach (Access to the Area)
	3	4	3	4	3	4	3	3	3	3	Outward view
	3	4	5	5	4	4	3	2	2	2	Area Specialty
	3	3	4	4	3	3	4	4	5	5	Site Approach From External view (assess from External)
	4	4	5	4	4	4	4	3	4	3	Quality of View
Relationship with Area utility											other
											1) Educational building area
											2) Administrative building area
											3) Dormitory building area
											4) Commercial area
											5) Recreational sports area
											6) Conservation area
											7) Agricultural Area
										8) Service and Maintenance Area	

Suitability of ZONING must be overlay analyzed to find the needs in detail of the area to be suitable for the Function Program according to the needs of the Faculty of Agriculture and Natural Resources. Rajamangala University of Technology Tawan-Ok for the land use of each zone. The 8 zones as follows: 1) Educational building area 2) Administrative building area 3) Residential area 4) Commercial area 5) Sports and recreation areas 6) Conservation areas 7) Agricultural land 8) Service, maintenance area. 8 Land use Functions leads to the needs of the space, the synthesis of the site potential to be suitable for the utilization of each activity that will be available in Bo Thong institution. In relation to the function program, it will be used to make a table model showing the relationship of scoring values of site potential of each zone that is suitable for the function program. There are scores valued 1-5. From ascending to descending which are shown in the form of Table 1.



Picture 6 Map showing the analysis of the site potential to the Zoning Design Guidelines, alternative 1



Picture 7 Map showing the analysis of the site potential to the Zoning Design Guidelines, alternative 2

The results of the research lead to the Zoning design guidelines, which can be classified into 8 areas, namely 1) Educational building area (yellow) 24%, 2) Administrative building area (pink) 7.5%,

3) Residential area (blue) 17%, 4) Commercial area (light orange) 9%, 5) Sports area Recreation (dark green) 23%, 6) Conservation Area (Purple) 5%, 7) Agricultural Area (Light Green) 10%, 8) Maintenance Service Area (Grey) 1%, and add 2 more connecting areas, namely 1) Plaza area (dark orange) 1%, and 2) 4 landmark areas (dark yellow) 2.5% in which the main road in the project is represented by a red dashed line. Secondary roads leading into each area are represented by a small red solid line. The Green Pedestrian or Green Way is represented by a green dotted line. And brown represents the area of the Royal Forest Department adjacent to the conservation area of the project. There are two possible approaches to designing the static zone: Approach 1: Utilizing the existing road as the main pathway (Picture 6) Approach 2: Creating a new road and transforming the existing road into a green connection (Picture 7)

4. Conclusion and suggestions

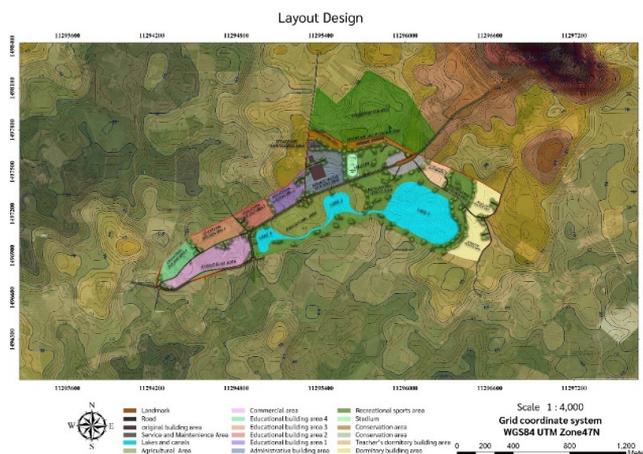
Creative development in project areas requires surveying, studying, and analyzing each sub-factor through the overlaying of maps. This process helps uncover the deep potential required for designing and planning the spatial layout of each zone according to the designated land use program. It leads to appropriate architectural and landscape designs. Research findings indicate that the site determines which functions are suitable, and the required functions determine the type of site.

In the development of green institutions, important considerations in management and administration include: 1. Energy and climate change: Strategies for sustainable energy sources and addressing climate change impacts. 2. Planning and infrastructure for public utilities: Designing an efficient and sustainable infrastructure for essential services such as water, electricity, and waste management. 3. Transportation and mobility: Developing a transportation system that promotes sustainable and efficient modes of travel, reducing carbon emissions and congestion. 4. Waste management: Implementing effective waste management practices, including recycling, waste reduction, and proper disposal methods. 5. Research: Conducting research to advance knowledge and innovation in sustainable practices, technology, and environmental conservation. 6. Water resources: Ensuring sustainable management of water resources, considering conservation, allocation, and quality control measures.

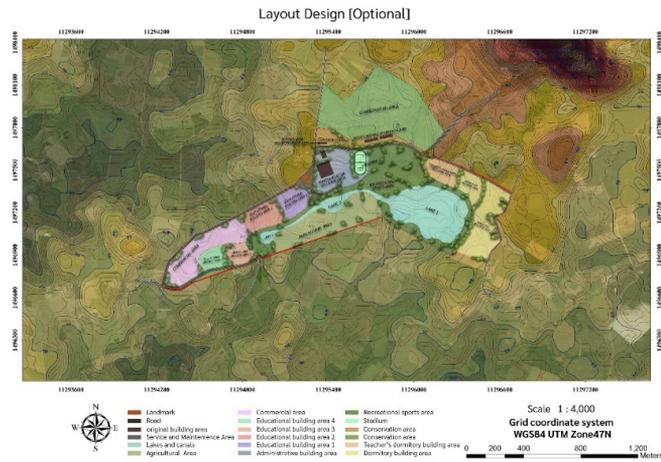
By considering these key issues in management and administration, the development of creative and sustainable projects can be achieved, leading to a greener and more environmentally conscious institution. The summary of the educational institution campus layout in Bo Thong can be outlined as follows: 1) Optimizing the layout to maximize efficiency: The campus layout should be designed in a way that enhances the existing space to its fullest potential, ensuring efficient utilization. 2) Community involvement and promotion: Encouraging community participation and collaboration in the development process to create a strong sense of community and foster mutual growth. 3) Sustainable energy and integrated agriculture: Promoting the use of renewable energy sources and implementing sustainable agricultural practices such as agroforestry and rotational farming. 4) Resource conservation and reuse: Reducing resource wastage through efficient management, promoting reuse

practices, and implementing water recycling systems. 5) Knowledge development for the community: Fostering the development of knowledge and education within the community, providing opportunities for learning and skill enhancement. 6) Development as a tourism landscape: Enhancing the campus to become a scenic and attractive destination for tourism, highlighting the unique features and promoting cultural and natural heritage. 7) Resource management and disaster prevention: Implementing effective resource management strategies and developing comprehensive plans for disaster prevention and mitigation.

In analyzing the potential of the Bo Thong area to be transformed into a green educational institution, the following analysis and recommendations for the campus layout can be made, considering eight zones: 1) Faculty of Agriculture Zone: Designated space for the agricultural faculty's classrooms and facilities. 2) Administration Zone: Area for administrative buildings, management offices, support facilities, and certification offices. 3) Faculty and Student Residential Zone: Residential space for faculty members and students. 4) Commercial Zone: Space for commercial activities, exhibition and trade centers, food courts, community service centers, and OTOP (One Tambon One Product) market. 5) Recreational Zone: Areas for sports, recreational activities, lakes, canals, and reservoirs. 6) Conservation and Forest Zone: Preserved areas for conservation and forest protection. 7) Agricultural Zone: Agricultural fields and farms. 8) Service Zone: Maintenance and service areas. Additionally, there are two connecting areas to enhance the green concept and provide focal points: 9) Plaza: A central plaza area that serves as a gathering space and promotes community interaction. 10) Landmark and Roundabout



Picture 8 Map showing Guidelines for Site Planning towards green campus, alternative 1



Picture 9 Map showing Guidelines for Site Planning towards green campus, alternative 2

Site planning design concept

The area for administrative buildings, educational buildings, service buildings, and maintenance facilities is considered based on the existing building area near the main internal roads within the project. This area consists of previously disturbed land that needs to be renovated according to architectural principles to enhance its aesthetic appeal. It should be surrounded by natural elements and should not obstruct the natural waterways entering the project area.

The residential area within the project is determined based on the accessibility to the deepest areas and proximity to recreational areas such as parks, public ponds, and lakes. It is situated in visually appealing areas with moderate slopes and excellent views. The atmosphere and views should not be disrupted by hazardous pollutants, dust, or natural disasters.

The commercial area is determined based on its closest proximity to the main access point, which is the first point of entry into the project. It is located along the primary internal road within the project. The area undergoes land improvement while ensuring it does not obstruct the natural waterways.

The recreational area, including public parks and sports fields, is determined based on its location in low-lying flat areas, natural water flow paths, and fertile soil. It is situated near water sources and allows for easy access to various functions within the project. It promotes walking and cycling as means of transportation, supporting residents' active lifestyles and reducing energy consumption from motor vehicles. The design ensures that pedestrian and cycling paths are separate from high-traffic roads to prioritize safety for residents.

The conservation and forest preservation area is designed to increase green space in the city and community. It serves as a recreational area for both passive and active activities in the form of a forest garden, allowing students and university staff to experience a diverse environmental system. The area is characterized by steep slopes and a significant number of existing forests, which can be developed into a forest that maintains the original characteristics of Bo Thong's natural forests. The

design explores the concept of a forest garden with a variety of rare and important tree species that may be difficult to find elsewhere. It aims to create awareness of the diverse wildlife that inhabits the forest and emphasizes the forest's role as a habitat for small animals, as well as its significance as a producer of essential resources such as water and clean air, which are vital for human survival.

The agricultural, horticultural, and fishery department areas are located in low-lying plains where some soil disturbance has occurred. Although there are not many large trees, the soil is fertile, and the area is close to water sources. The connection to water bodies allows for the distribution of moisture to the surrounding soil, aligning with the concept of incorporating mound, wetland, and paddy field models. The small canals play a role in distributing moisture to plant species. Moreover, the water connectivity contributes to the diversity of both aquatic and riparian ecosystems. It serves as a habitat for aquatic animals, an egg-laying site, and also helps facilitate water circulation through the design and layout of the area.

The green connectivity areas, including landmarks, roundabouts, and plazas, are designed to enhance the land use benefits of all eight zones by providing pedestrian and bicycle-friendly green pathways that seamlessly connect to each zone without intersecting with vehicular traffic routes. Landmarks, roundabouts, and plazas are strategically placed in junctions or intersections with three to four roads, allowing road users to easily identify and remember the characteristics of each zone as local landmarks. They also serve as speed regulators for motor vehicles before reaching the intersections. Additionally, these areas provide open spaces along the roadways with gentle curves and viewpoints, allowing certain areas to enjoy the beautiful scenic views of the project's surrounding environment.

Ponds or lakes are water bodies that are important components of the environment. In urban and landscape planning, they hold significant importance in various aspects and are closely related to people's way of life, including agriculture, culture, and tourism. They serve as recreational areas and places for relaxation. Utilizing the water resources spanning over 100 acres in the area can be a driving force for development in multiple aspects. For instance, they can be open spaces along the waterfront, with roads meandering through the riverbanks, activity areas, public parks, and residential areas.

The decision to have curved or straight riverbank edges depends on whether it would be more beneficial to combine both designs for the improvement of the existing area. The riverbank should have a suitable slope that is not too steep, allowing access to the water in various ways, both in natural and manmade areas. Creating a riverfront public park would enable people in the area and the community to have closer interaction with nature.

The recommendation for Green campus based on SDG are creating a green university aligned with Sustainable Development Goals involves integrating sustainability into various aspects:

1. Curriculum Design

- Develop courses that address environmental, social, and economic sustainability.
- Incorporate SDGs into existing programs and create interdisciplinary courses.

2. Campus Operations
 - Implement energy-efficient technologies and renewable energy sources.
 - Establish waste reduction and recycling programs.
 - Promote water conservation measures.
3. Infrastructure and Design
 - Construct eco-friendly buildings using sustainable materials.
 - Design green spaces and promote biodiversity on campus.
4. Transportation
 - Encourage eco-friendly commuting options (cycling, public transit).
 - Provide electric vehicle charging stations.
5. Community Engagement
 - Foster partnerships with local communities to address regional SDGs.
 - Organize awareness campaigns and events on sustainability.
6. Research Initiatives
 - Support research projects focused on sustainable solutions.
 - Encourage faculty and student involvement in sustainability research.
7. Governance and Policies
 - Develop and enforce sustainability policies for the university.
 - Establish a sustainability committee to oversee initiatives.
8. Student Involvement
 - Encourage student-led sustainability clubs and initiatives.
 - Integrate sustainability into student orientation programs.
9. Global Collaboration
 - Engage in international partnerships to address global sustainability challenges.
 - Participate in conferences and initiatives promoting SDGs.
10. Monitoring and Reporting
 - Implement systems to monitor and measure sustainability performance.
 - Regularly report progress on SDGs to stakeholders.

In conclusion, establishing a green university committed to the Sustainable Development Goals (SDGs) requires a holistic approach encompassing curriculum design, campus operations, infrastructure, community engagement, research initiatives, governance, student involvement, and global collaboration. By integrating sustainability into every facet of its existence, from energy-efficient buildings to eco-friendly transportation options, a green university can serve as a beacon for environmental, social, and economic responsibility. The ongoing commitment to monitoring, evaluating, and adapting initiatives ensures that the university remains at the forefront of sustainable practices, contributing significantly to the global pursuit of a more environmentally conscious and socially equitable future.

Summary of benefit and draw backs of digital geographic model
Advantages and Disadvantages of Creating Digital Models and Designing Digital Cartography.**

Advantages

1. **Testing and Simulation:** The use of digital models helps test various scenarios and simulate potential impacts before implementing the actual project, reducing risks and post-implementation problem-solving costs.

2. **Resource Efficiency:** Digital models aid in efficient resource management by allowing for precise planning and analysis, minimizing resource wastage during the design and planning phases.

Disadvantages

1. **Technical Complexity:** The creation and utilization of digital models and digital cartography require technical expertise, and individuals involved may need specialized training, potentially posing a barrier to widespread adoption.

2. **Initial Costs:** Implementing digital models and digital cartography systems may involve significant initial costs for acquiring technology, software, and training personnel, which could be a constraint for some organizations or projects.

Recommendations for future researches are to study feasibility and analyze benefit and limitation of 2 master plan patterns to apply in a site planning for each zone. It is recommended to add more details of site planning for each zone in order to smoothen development plan including budgets and construction phrases.

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