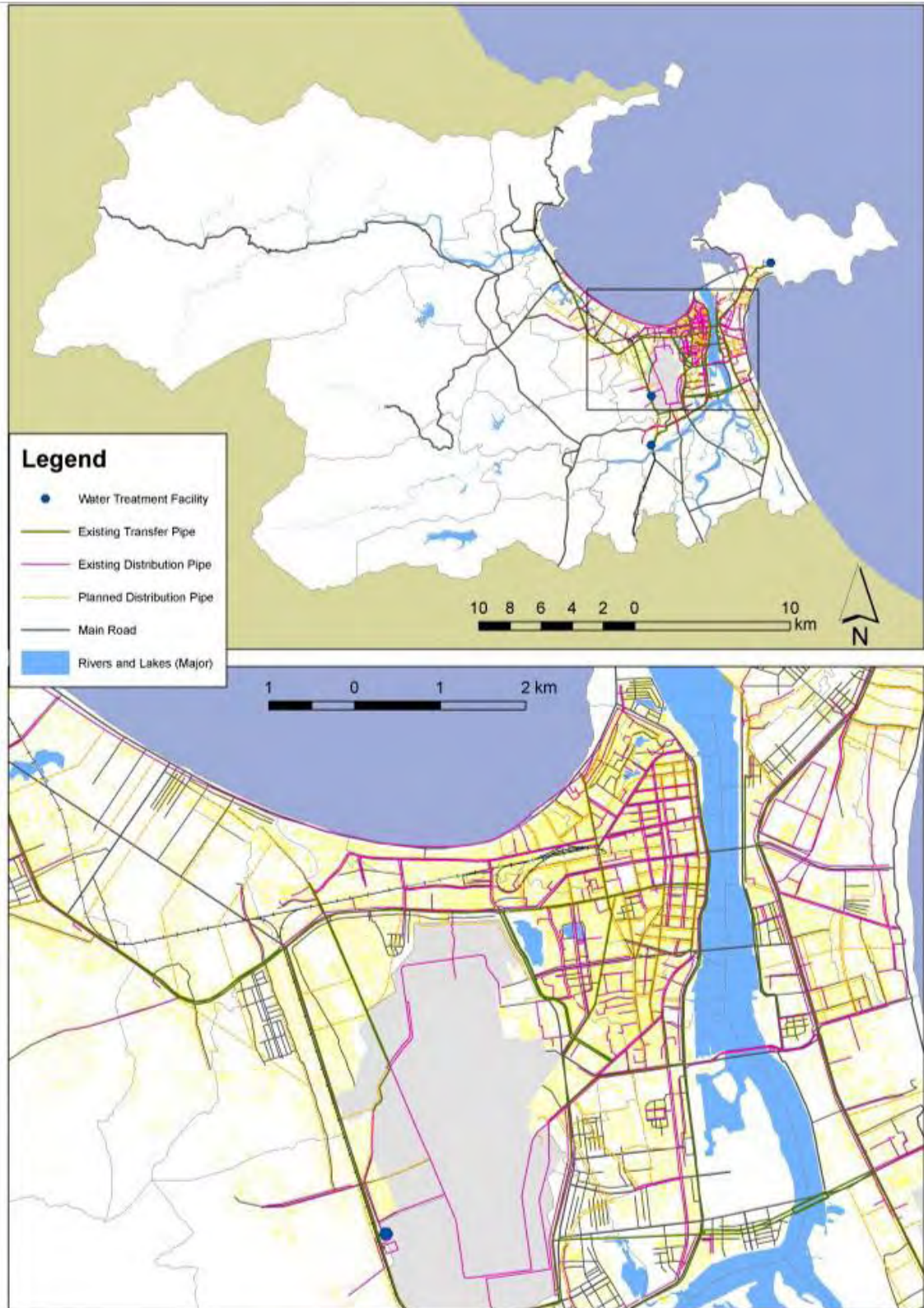


7 URBAN UTILITIES IN DANANG CITY

7.1 Water Supply

Figure 7.1 Water Supply Network in Danang City



Source: DOT, 2008.

Explanation:

7.1 The water supply network in Danang City includes transfer pipes, distribution pipes, and water treatment plants. The main water source and intakes are from the Vu Gia–Thu Bon river basin.

7.2 As shown in this map, a centralized system was developed in the city while independent tube wells were provided in suburban areas. Now, Danang has three water treatment plants which are the Cau Do water treatment plant with a design capacity of 120,000 m³/day), San Bay water treatment plant with a design capacity of 30,000 m³/day, and Son Tra water treatment plant with a design capacity is 5,000 m³/day. Regarding the system of transfer and distribution pipes, the Da Nang Water Service Company plans to extend its water pipeline network in order to provide potable water to 140,000 households by 2010.

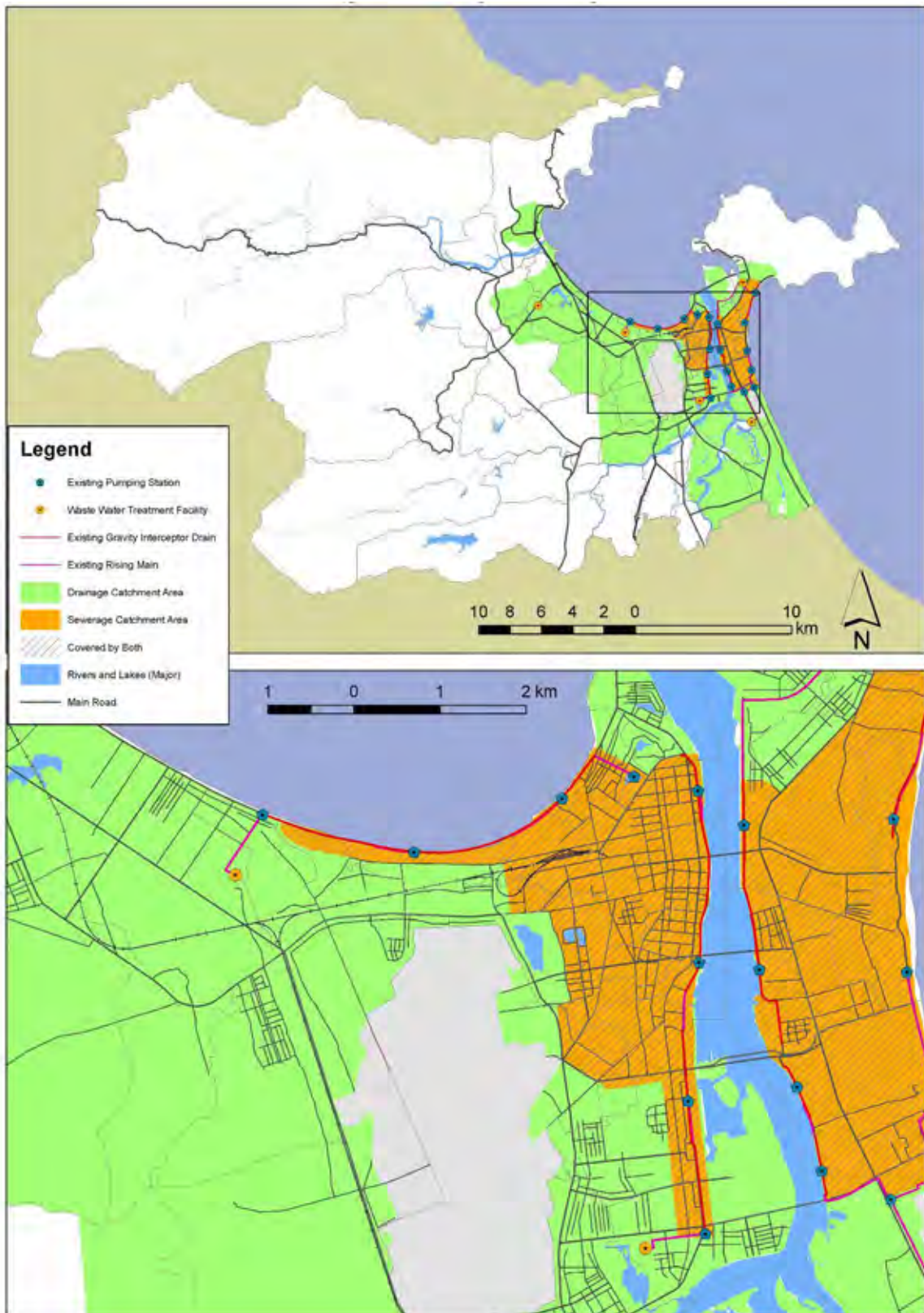
Table 7.1 Water Supply Network in Danang City by District

District	Total Length of Pipes (km)			
	Existing Transfer Pipe	Existing Distribution Pipe	Total of Existing Pipe	Planned Distribution Pipe
Hải Châu	23.5	81.7	105.2	49.7
Thanh Khê	15.6	41.2	56.8	16.5
Liên Chiểu	15.0	21.2	36.2	18.0
Cẩm Lệ	12.2	17.3	29.4	19.1
Ngũ Hành Sơn	10.2	11.0	21.2	22.9
Sơn Trà	11.3	42.4	53.7	23.8
Hòa Vang	0	0	0	0
Tổng	87.7	214.8	302.5	150.0

Source: PIP 2007, DaCRISS GIS Database, 2008.

7.2 Sewerage and Drainage

Figure 7.2 Sewerage and Drainage Network in Danang City



Source: PPIP 2007.

Explanation:

7.3 Central Danang City has a combined sewerage system. Wastewater and rainfall are collected in trunk drains, at the end of which are chambers which separate wastewater and manage counter flow from the sea. Separated wastewater is pumped and transferred to wastewater treatment plants where the chambers and pumps are operated manually.

7.4 The combined drainage system in Danang includes storm water drainage and sewerage systems. This system includes 18 existing pumping stations, four wastewater treatment facilities (excluding the waste treatment system of Khanh Son landfill in Lien Chieu district), existing gravity interceptor drain, and existing rising main. The total length of sewerage network is around 290 km.

Table 7.2 Capacities of Wastewater Treatment Facilities in Danang City

Location Name	Capacity (m ³ /day)
Son Tra No.1	32,600
Phu Loc	120,000
Hoa Cuong	120,000
Ngu Hanh Son	18,000
Total	290,600

Source: JICA Preparatory Study for DaCRISS, 2008.

7.5 The map also shows the separate drainage and sewerage catchment areas, as well as the combined catchment area, in the city center.

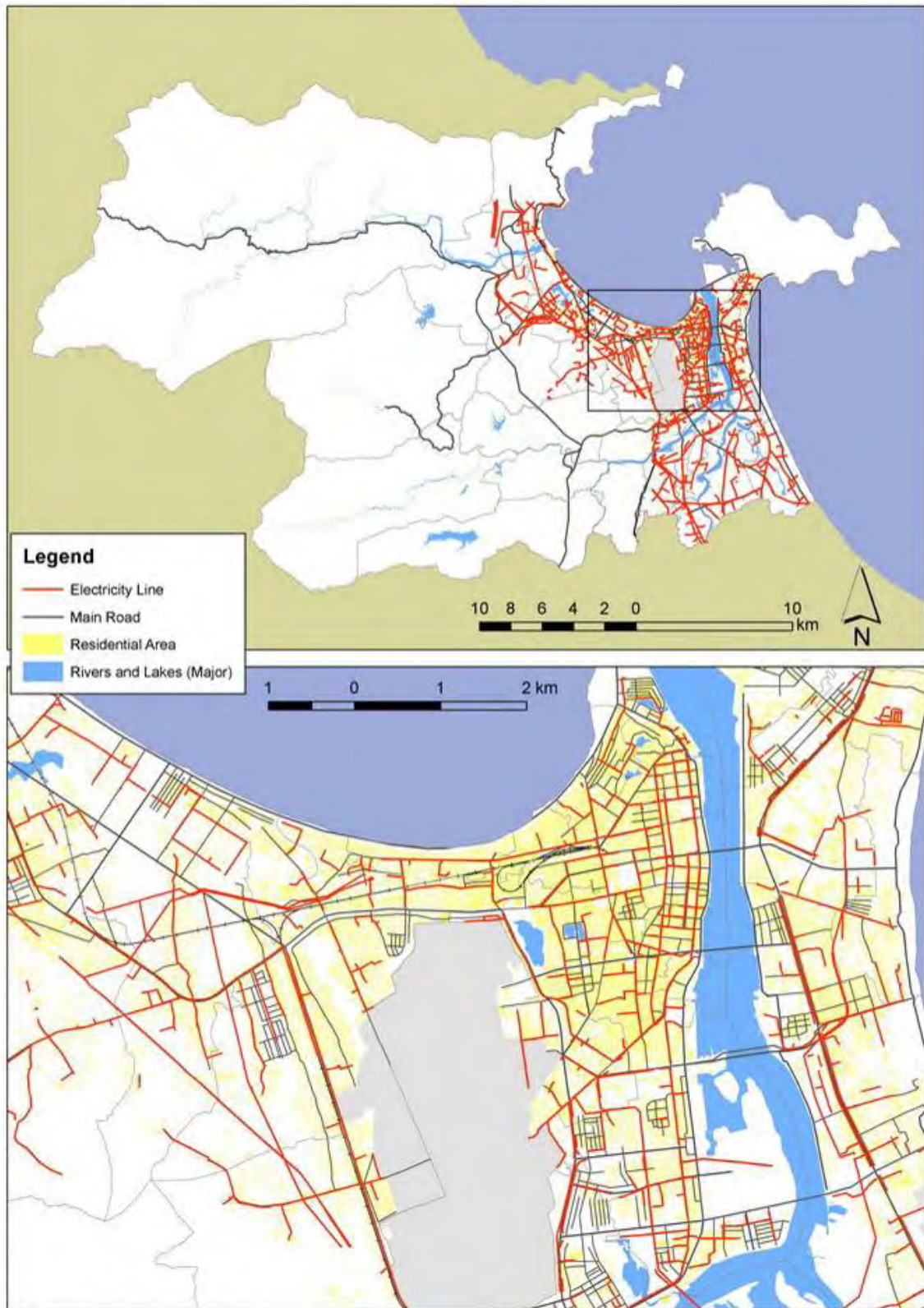
Table 7.3 Drainage and Sewerage Catchment Areas in Danang City by District

District	Area of Catchments (ha)		
	Drainage Catchment	Sewerage Catchment	Combined Catchment
Hai Chau	1,879	565	563
Thanh Khe	891	228	225
Lien Chieu	3,925	0	0
Cam Le	2,970	0	0
Ngu Hanh Son	3,536	319	317
Son Tra	1,410	765	731
Hoa Vang	1,147	0	0
Total	15,758	1,877	1,836

Source: Various documents from city authorities.

7.3 Power Supply

Figure 7.3 Power Supply Network in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

7.6 Danang receives electricity from Hoa Binh hydropower plants through the north–south ultra-high-voltage (500 kV) transmission lines. This power meets the people’s demand for production and consumption. All communes in Hoa Vang district have power for production and domestic activities. The city is currently investing more to expand and renovate this power transmission system.

7.7 The power supply network in Danang City was developed based on the “Electricity Development Plan for Danang City for the Period 2007–2010 with an Orientation toward Year 2015.” It was developed ahead of schedule due to rapid demand increase. Additional development of the supply network, including substations and distribution network, will cover new development areas.

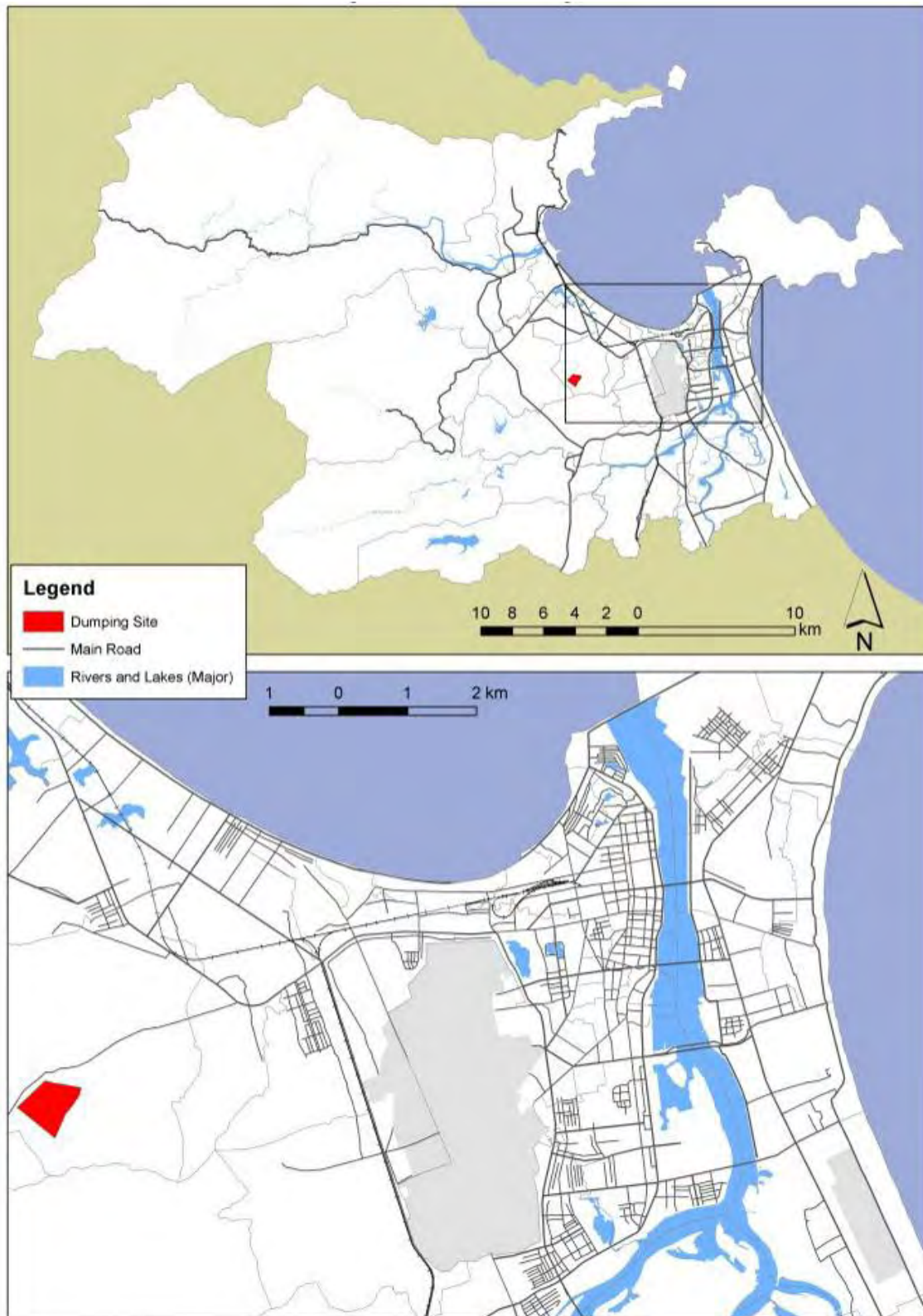
Table 7.4 High-tension Line Network in Danang City

District	Electric Cable Length (km)
Hai Chau	53.9
Thanh Khe	29.0
Lien Chieu	112.8
Cam Le	51.3
Ngu Hanh Son	67.2
Son Tra	35.3
Hoa Vang	67.5
Total	417.0

Source: Various documents from city authorities.

7.4 Solid Waste Management

Figure 7.4 Solid Waste Management in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

7.8 Shown in this map is the Khanh Son landfill site whose profile is shown in the table below.

Table 7.5 Profile of the Khanh Son Landfill Site

Name	Khanh Son Dumping Site
Management Company	URENCO (under DONRE)
Area	27 ha
Constructed Year	1993
Volume of Garbage in DN City	630 (t/day)
Collected Garbage	536 (t/day)

Source: JICA Preparatory Study for DaCRISS

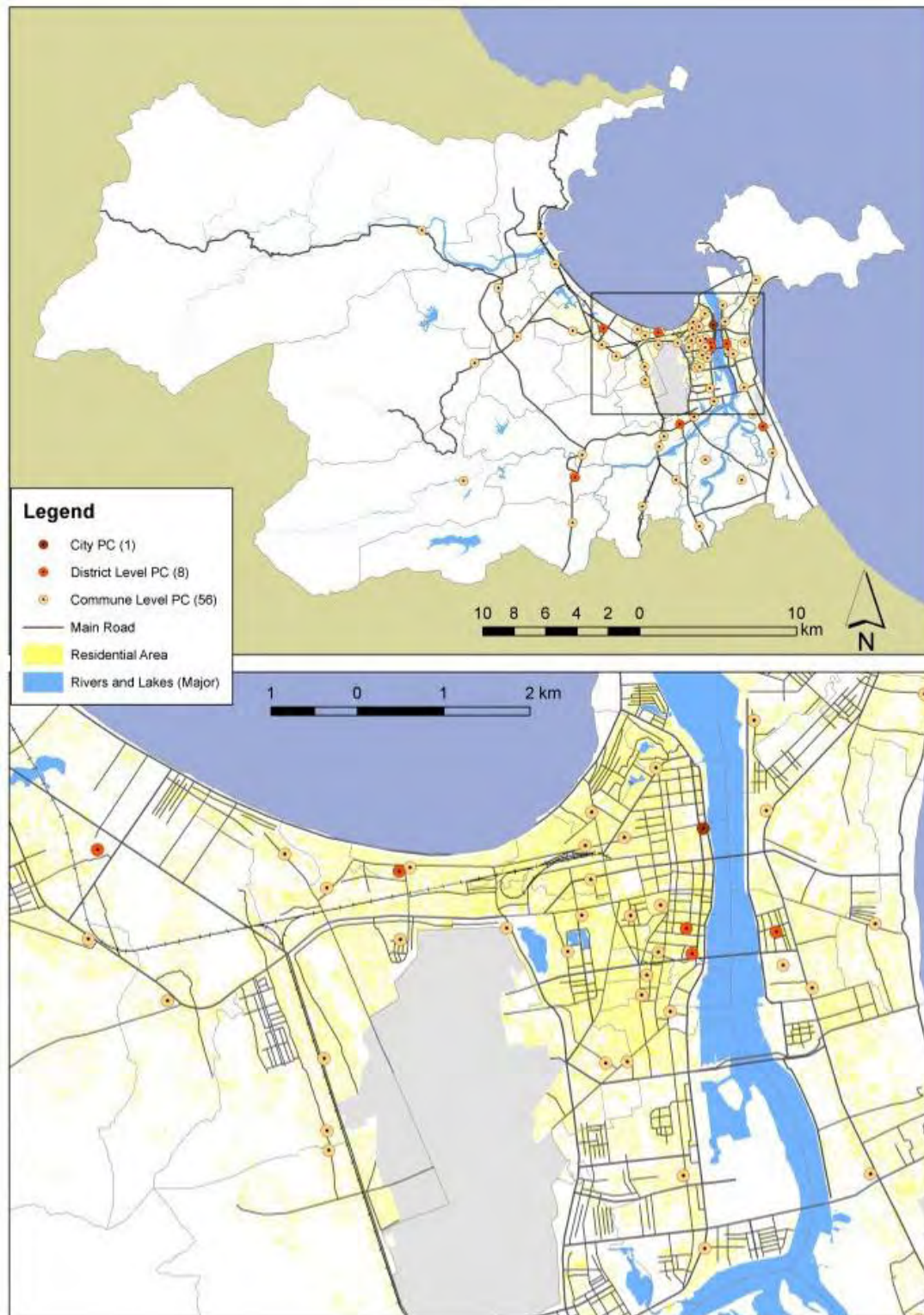
7.9 Based on the estimates of the Urban Environmental Company (URENCO), the domestic waste generated in Danang City reaches 630 tons a day, 85% of which the company collects. URENCO collects wastes daily in the city's central districts.

8 URBAN FACILITIES IN DANANG CITY

8.1 Administrative Facilities

1) People's Committee Offices

Figure 8.1 Locations of People's Committee Offices in Danang City



Source: 1:10,000 Topographic Map, 2006.

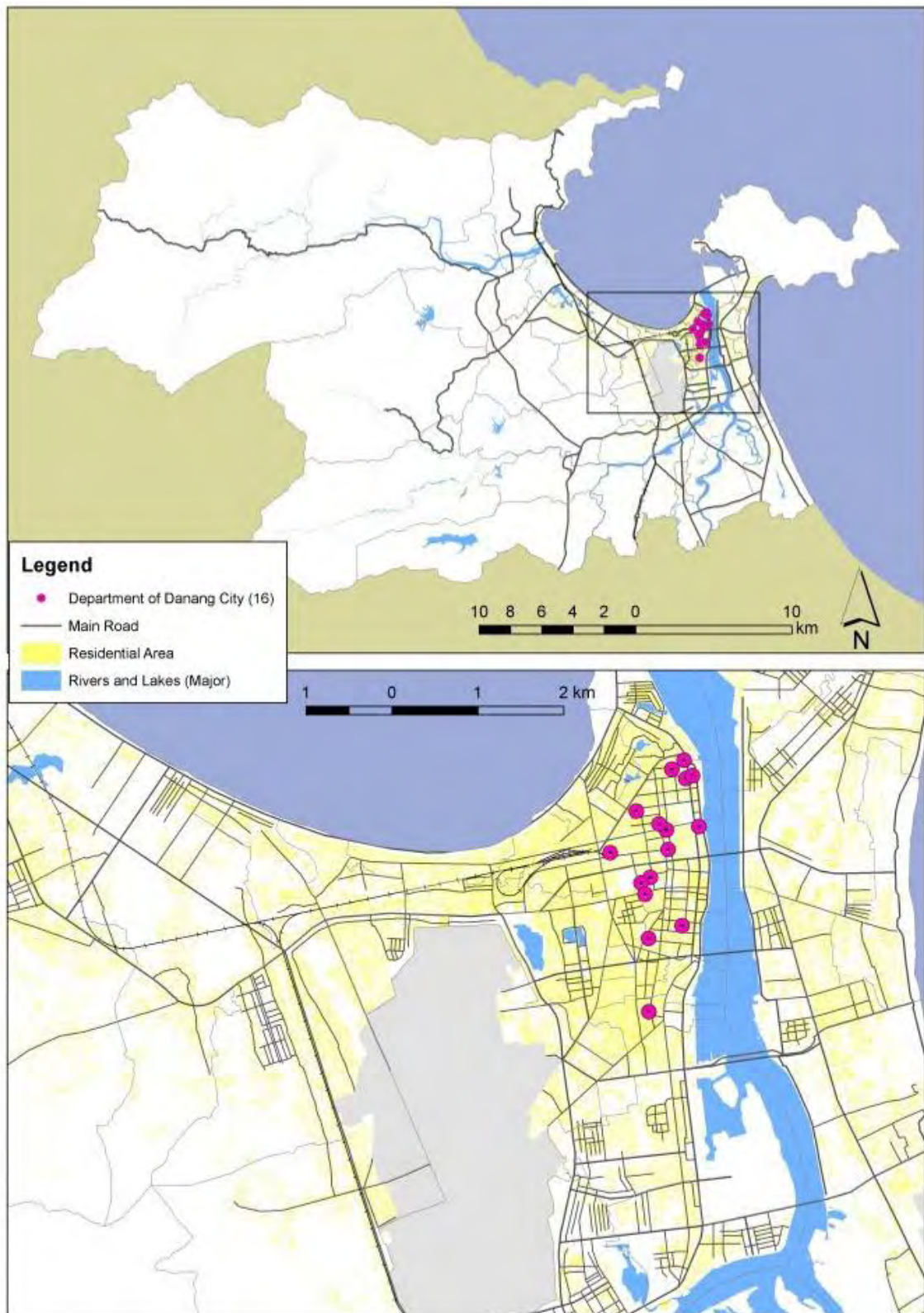
Explanation:

8.1 The People's Committee (PC) office of Danang City has one office at the city level, one in each of the eight districts and in each of the 56 communes. The Danang PC office is located in the urban district of Hai Chau, the city center.

8.2 Almost all the PC offices are located in the center of districts or communes and along major roads, making them accessible to people who deal with administrative procedures. Moreover, the distances between these PC offices are not so long; hence communication and coordination among PC offices are easy to carry out.

2) Departments of Danang City

Figure 8.2 Locations of Government Department Offices in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.3 The map shows all government departments in Danang City, of which there are 16 and are concentrated in Hai Chau district. The list of the departments and their size, as well as locations, are provided below.

Table 8.1 Locations of Government Departments Offices in Danang City

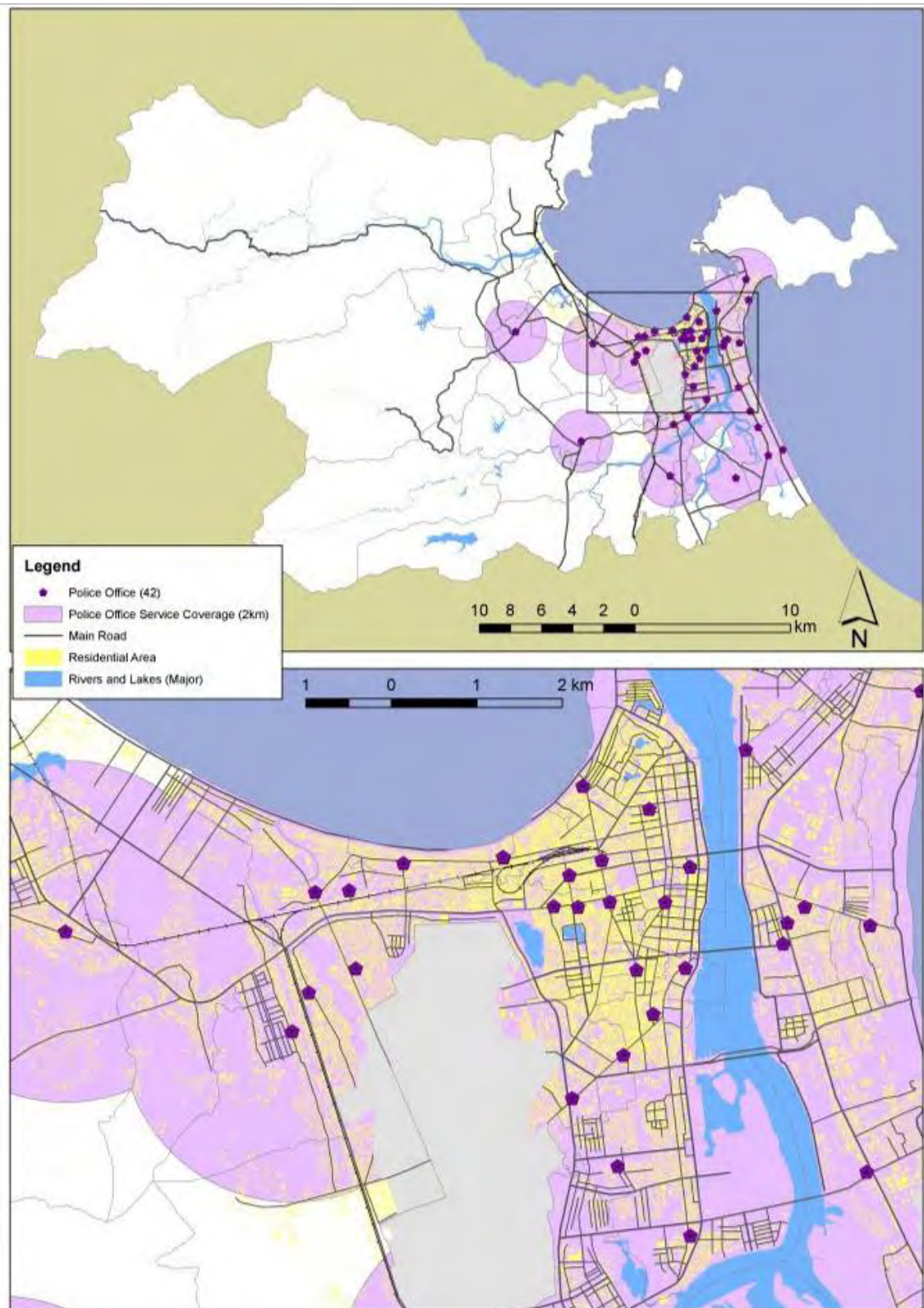
Department Name	Area (m ²)	Commune
Da Nang People's Committee	5841.24	Hai Chau 1
Department of Finance	3291.13	Thach Thang
Department of Transportation	1983.57	Thach Thang
Labor , War Invalids & Social Affairs Department	1260.69	Binh Thuan
Department of Natural Resources & Environment	693.95	Hai Chau 1
Department of Science , Technology	960.67	Thach Thang
Department of Foreign Affairs	1194.54	Thach Thang
Department of Industry and Trade	1289.85	Thach Thang
Department of Justice	1582.21	Thach Thang
Department of Culture, Sport & Tourism	1111.38	Thach Thang
Department of Agriculture and Rural Development	724.01	Hai Chau 1
Department of Planning & Investment	1056.65	Hai Chau 1
Department of Health	1391.77	Hai Chau 1
Department of Internal Affairs	512.60	Phuoc Ninh
Department of Construction	621.98	Phuoc Ninh
Department of Training & Education	2781.04	Hai Chau 1

Source: Various documents from city authorities.

Note: Areas were calculated by GIS based on the 1:10,000 topographic map.

3) Police Stations

Figure 8.3 Locations of Police Stations in Danang City



Source: 1:10,000 Topographic Map, 2006.

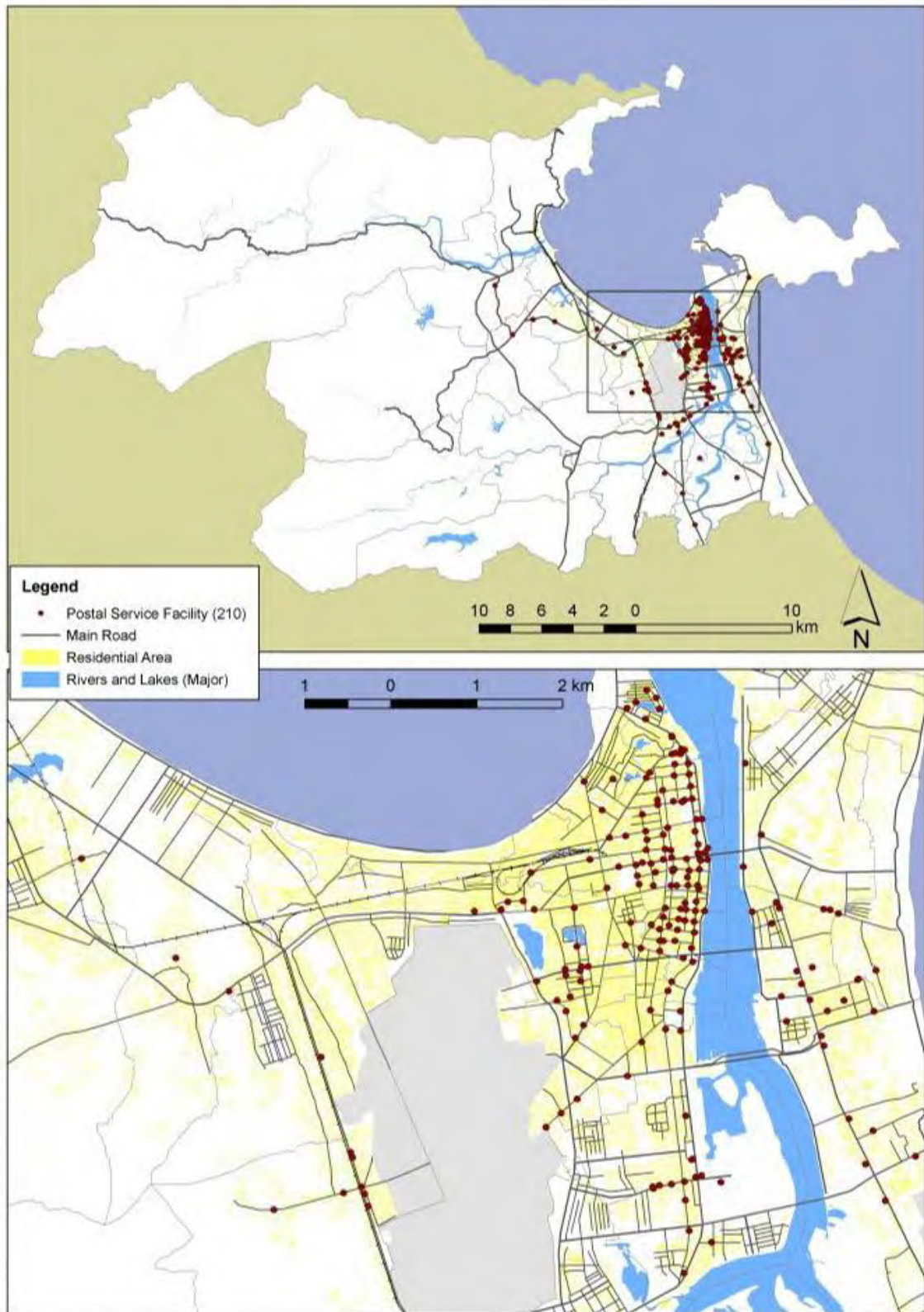
Explanation:

8.4 This map shows only the 42 police stations identified by the DaCRISS Study Team. In reality, Danang City has 23 more which work at securing public order and security. Some stations cannot be located in this map because of the lack of relevant information about their exact locations.

8.5 The coverage of each police station is the area within a radius of 2 km from the station. In the map, this is shown by a circle. Obviously, the coverage of police stations is dense in the central urban area, but sparse in suburban areas, especially in the mountainous areas.

4) Post and Telecommunication Facilities

Figure 8.4 Locations of Post and Telecommunication Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

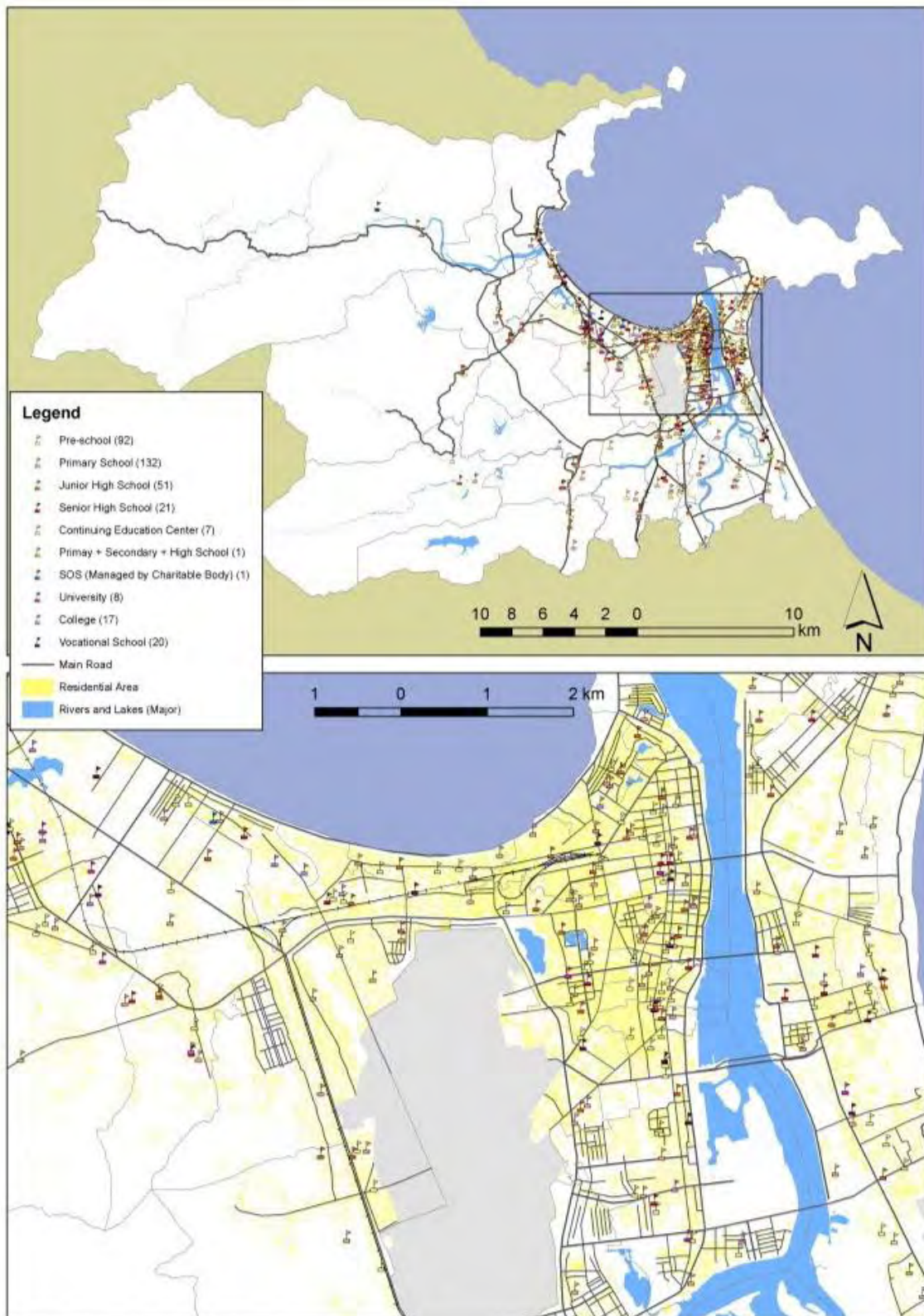
8.6 There are 210 post and telecommunication facilities in Danang City, including post offices, public telephone booths, and telecommunications centers. These are concentrated in urban districts.

8.7 Danang is now considered one of the three largest telecoms centers in Vietnam with modern and convenient services. The telecommunications network in Danang City now has two main switchboards and 12 minor switchboards with a total capacity of 40,000 phone numbers. In general, the quality and quantity of telecoms services have been increasingly enhanced.

8.2 Social Facilities

1) Educational Facilities

Figure 8.5 Locations of Educational Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.8 This map was built based on data from DOET and the 2006 topographic map with a 1:10,000 scale.

8.9 Danang is one of the major education and training centers in Central Vietnam, the western highlands, and Vietnam in general. The education system consists of universities, institutes, colleges, intermediate schools, vocational schools, and schools from high school to pre-school.

Table 8.2 School Classification in Danang City

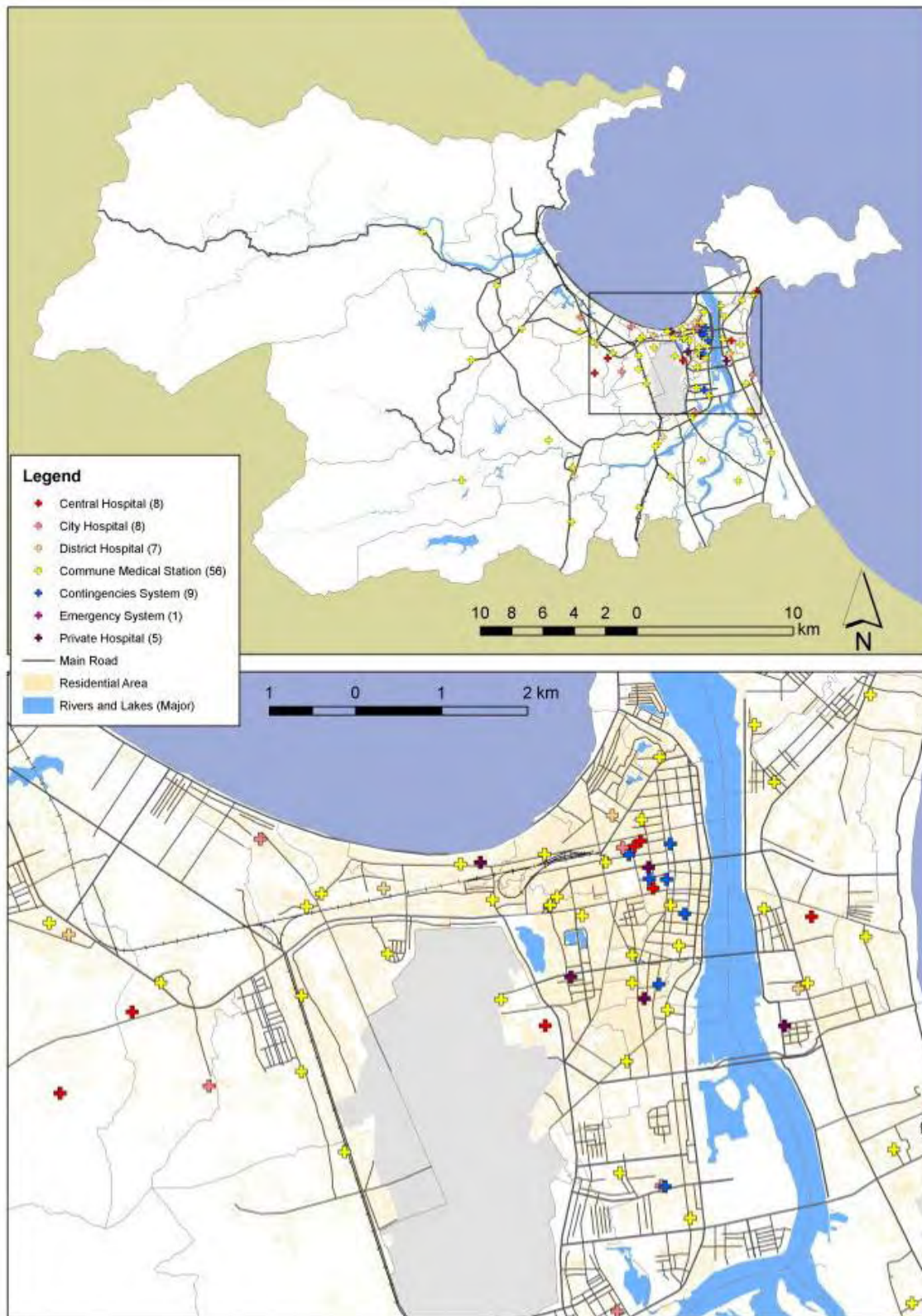
Type of School	Age (years old)	Total Number
Pre-school (including Kindergarten)	<5	52
Primary School	6–11	104
Junior High School	12–15	51
Senior High School	16–18	22
University	19–23	8
College	19–20	16
Continuing Education Center ((school for students who fail to enter normal schools)	6–17	6
Vocational School (including junior-level vocational school, senior level vocational school, and intermediate school)	18–19	18
Total		277

Source: Prepared by DaCRISS based on the interview to DOET, 2008

8.10 Based on a project of the Danang University and approved by the Ministry of Education and Training, Danang will establish more universities and research institutes up to 2015, such as the International University, Information Technology and Communication University, Medicine and Pharmaceutical University (upgrading from the existing Faculty of Medicine and Pharmacy), Medical Technology University, Open University, and graduate schools.

2) Health Care Facilities

Figure 8.6 Locations of Health Care Facilities in Danang City

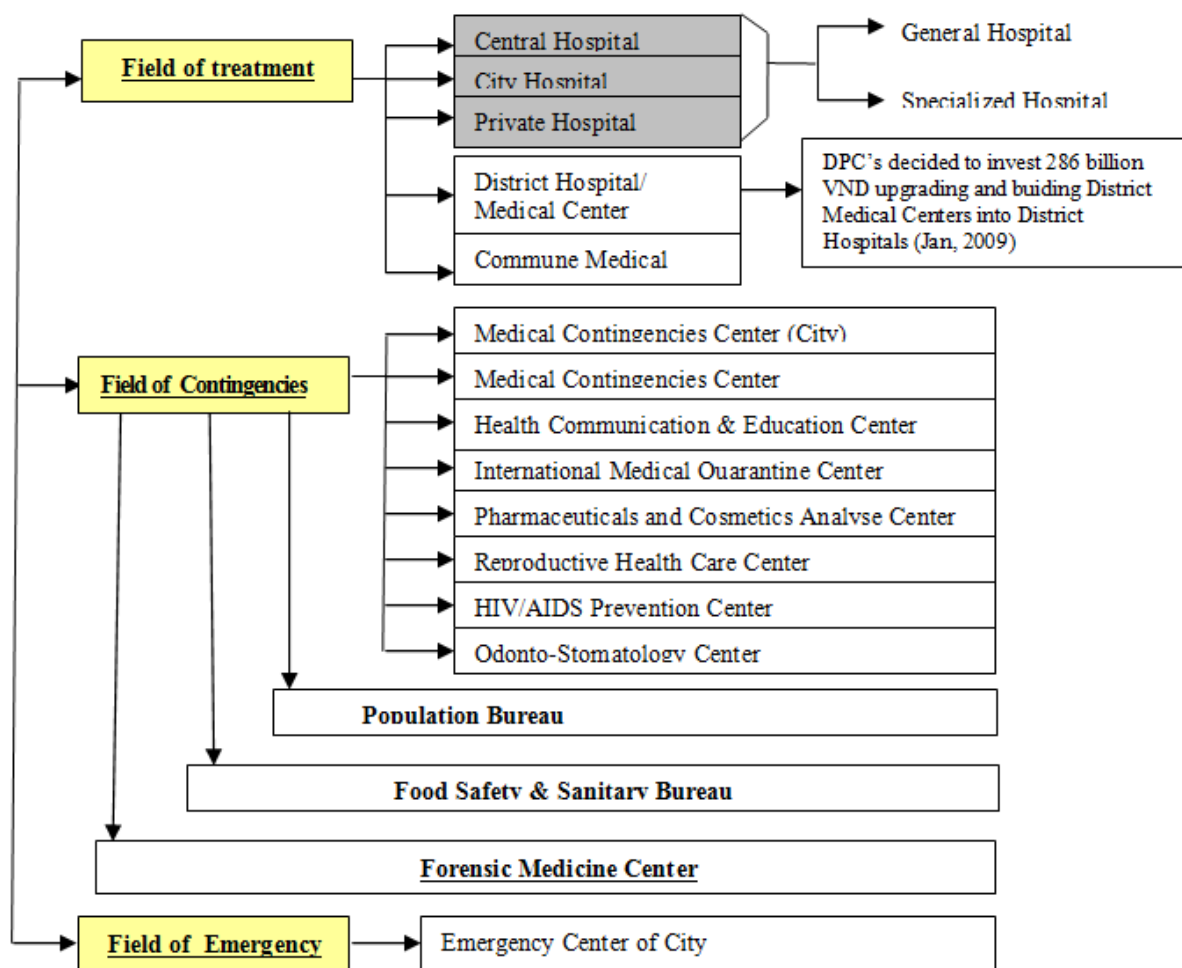


Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.11 The map shows the locations of health care facilities in the city, while the figure below classifies the health care system.

Figure 8.7 Health Care System in Danang City



Source: Various documents from city authorities.

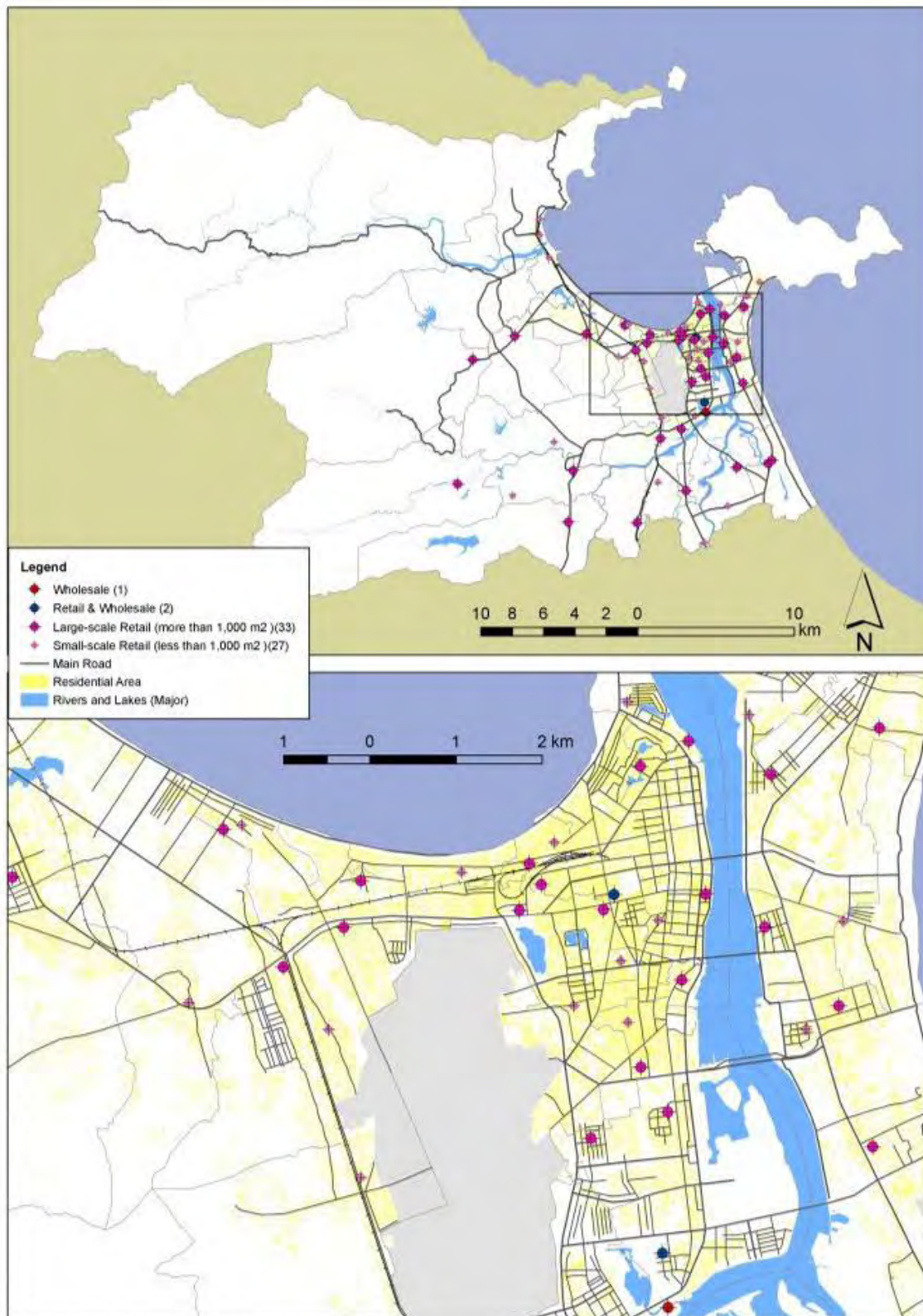
Table 8.3 Classification of Hospitals in Danang City

Level	Type of Hospital	Number
City Hospital		1
Specialized Hospital	Specialized hospital	6
Population Bureau	Population bureau	1
Medical Center	City medical center	11
	District medical center	6
	Commune medical center	56
Total Number of Hospitals		81
Total Number of Doctors (Number in () shows the number of females in the total)		732 (269)
Total Number of Staff (Number in () shows the number of females in the total)		2,818 (1,922)

Source: DOH, 2008

3) Commercial Facilities

Figure 8.8 Locations of Commercial Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.12 The commercial infrastructure in Danang City is comprehensive and modern with a system of commercial centers and supermarkets, wholesale markets, large-scale and small-scale retail markets.

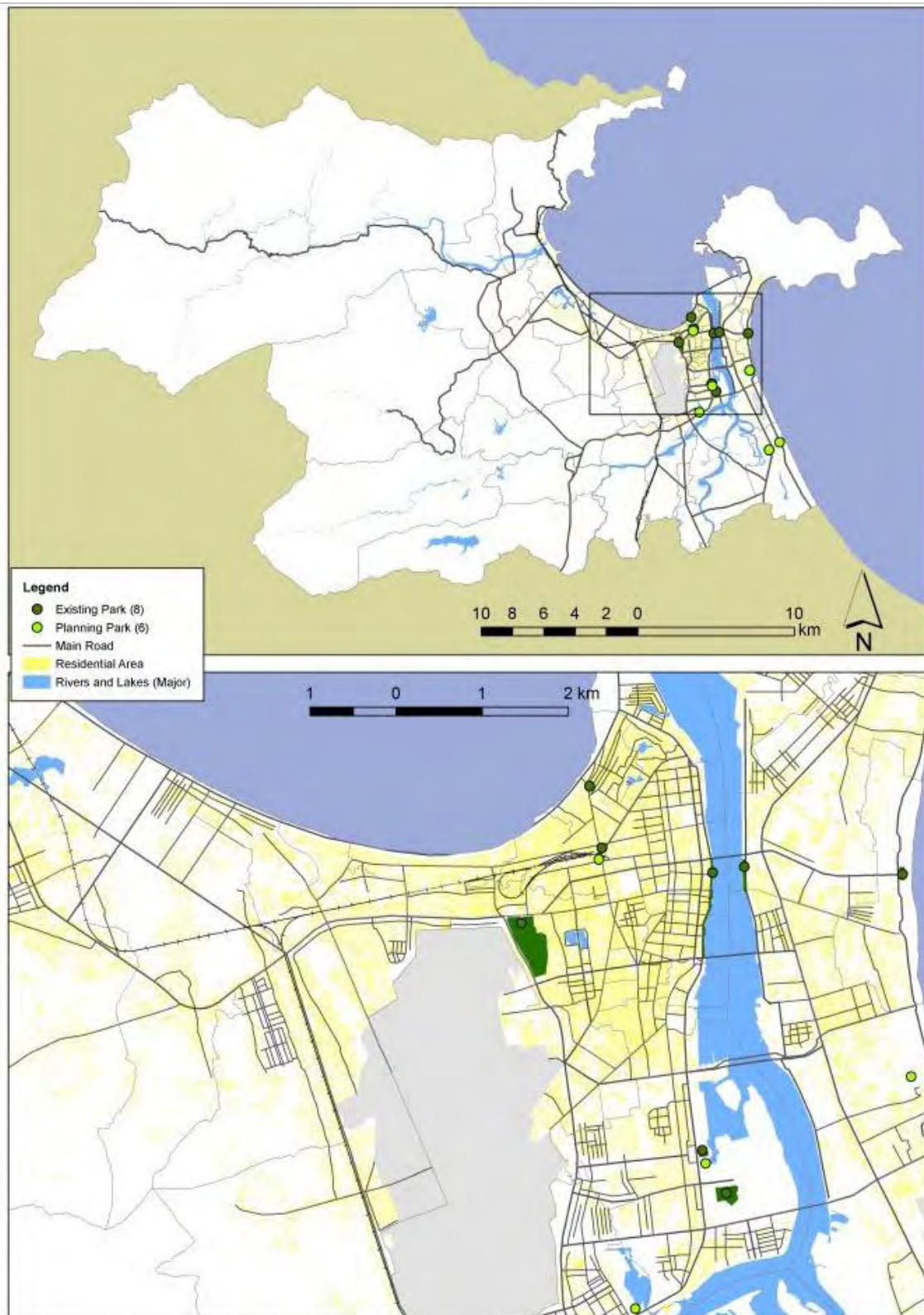
8.13 Based on the topographic map and data collected from the Department of Industry and Trade (DOIT), the DaCRISS Study Team identified one wholesale market, two wholesale and retail markets, 33 large-scale retail markets with an area of more than 1,000 m², and 27 small-scale retail markets with an area of less than 1,000 m² each in almost all communes in Danang City.

8.14 As shown in the map, large-scale markets are evenly distributed, satisfying the increasing consumption and shopping demands of the people in Danang City. Danang now has two large markets, i.e., the Han and Con markets, located in the central area and some new ones such as the Bai Tho Plaza, Metro, Big C, Coop Mart, Intimex, Viettronimex, De Nhat Phan Khang, Nhat Linh, Dai Duong, and Nguyen Kim Sai Gon.

8.3 Cultural and Recreational Facilities

1) Parks

Figure 8.9 Locations of Parks in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.15 This map shows the locations and areas of some existing and planned parks in Danang City.

8.16 According to statistics, the average area of parks in Danang is 0.45 m²/person. By district, it is 0.583 m²/person in Hai Chau district, 1.19 m²/person in Thanh Khe district, 0.43 m²/person in Son Tra district, while there are no parks in Ngu Hanh Son, Cam Le, Lien Chieu, and Hoa Vang districts. Currently, there are eight existing parks, with 29-3 park as the biggest. In general, park area/person in Danang is too small; it does not meet the citizen's demand and the city's standards. Therefore, planning parks and green spaces is essential for Danang to become an environmental city in the future.

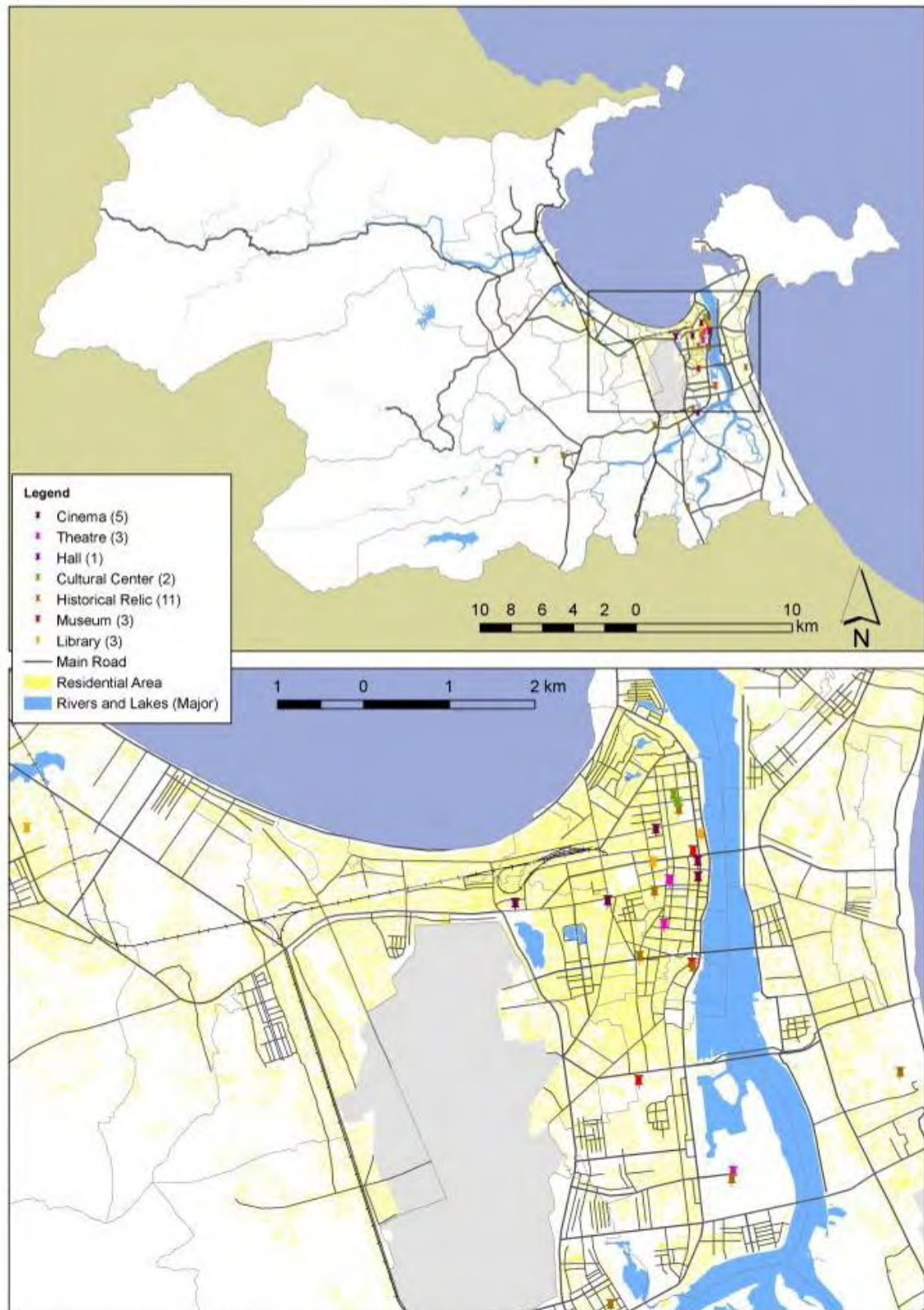
Table 8.4 Parks in Danang City

Name	Location	Planned Area (m ²)	Status	Description
1. 29-3 Park	Thanh Khe District	199,334.0	Existing	green and entertainment park
2. Water park	Hoa Cuong Bac Ward, Hai Chau District	52,249.0	Existing	
3. North Monument Park	Hoa Cuong Bac Ward, Hai Chau District	105,097.0	Existing	
4. East Bach Dang Side-walk-Park	Son Tra District		Existing	entertainment park with greenery, parterres, ponds, and statues
5. West Bach Dang Side-walk Park	Hai Chau District		Existing	
6. Pham Van Dong Coastal Park	Hai Chau District		Existing	
7. Dong Da- Ong Ich Khiem Park	Thanh Khe District		Existing	entertainment park
8. Thanh Binh Park	Ong Ich Khiem Street		Existing	green and entertainment park
9. Youth Park	Khue Trung Ward, Cam Le District and Hoa Cuong Nam Ward, Hai Chau District	296,219.3	Planning	
10. A park to preserve historical monuments	Bac My An Ward, Ngu Hanh Son District		Planning	a park to preserve historical monuments K20
11. Cultural and tourism park	Ngu Hanh Son landscape, in Hoa Hai Ward, Ngu Hanh Son District	1,371,686.0	Planning	a significant cultural and tourism park in the central region
12. Ngu Hanh Son sculptured statues Park	In the North of Thuy Son Mountain, in Hoa Hai ward, Ngu Hanh Son District	166,963.0	Planning	a place for celebration of sculpture Festival
13. Botanical and zoological park	in Hoa Xuan ward, Hoa V District	1,880,000.0	Planning	
14. Hai phong- Ong Ich Khiem Park	in the bordering of Thanh Khe and Hai Chau District	13,997.0	Planning	green park
15. Gymnastics and Sport Park	South East Memorials Park in North Hoa Cuong ward, Hai Chau District	1,081,700.0	Planning	

Source: Urban Planning Institute (UPI), 2008.

2) Cultural and Recreational Facilities

Figure 8.10 Locations of Cultural and Recreational Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.17 Danang has five cinemas, three theaters, one hall, two cultural centers, 11 historical relics, three museums, and three libraries. Most cultural facilities (except for some historical relics) are concentrated in urban areas. Therefore, it is necessary to strengthen and expand the coverage of cultural facilities to suburban areas, especially in mountainous and rural areas where public facilities and infrastructures are still missing.

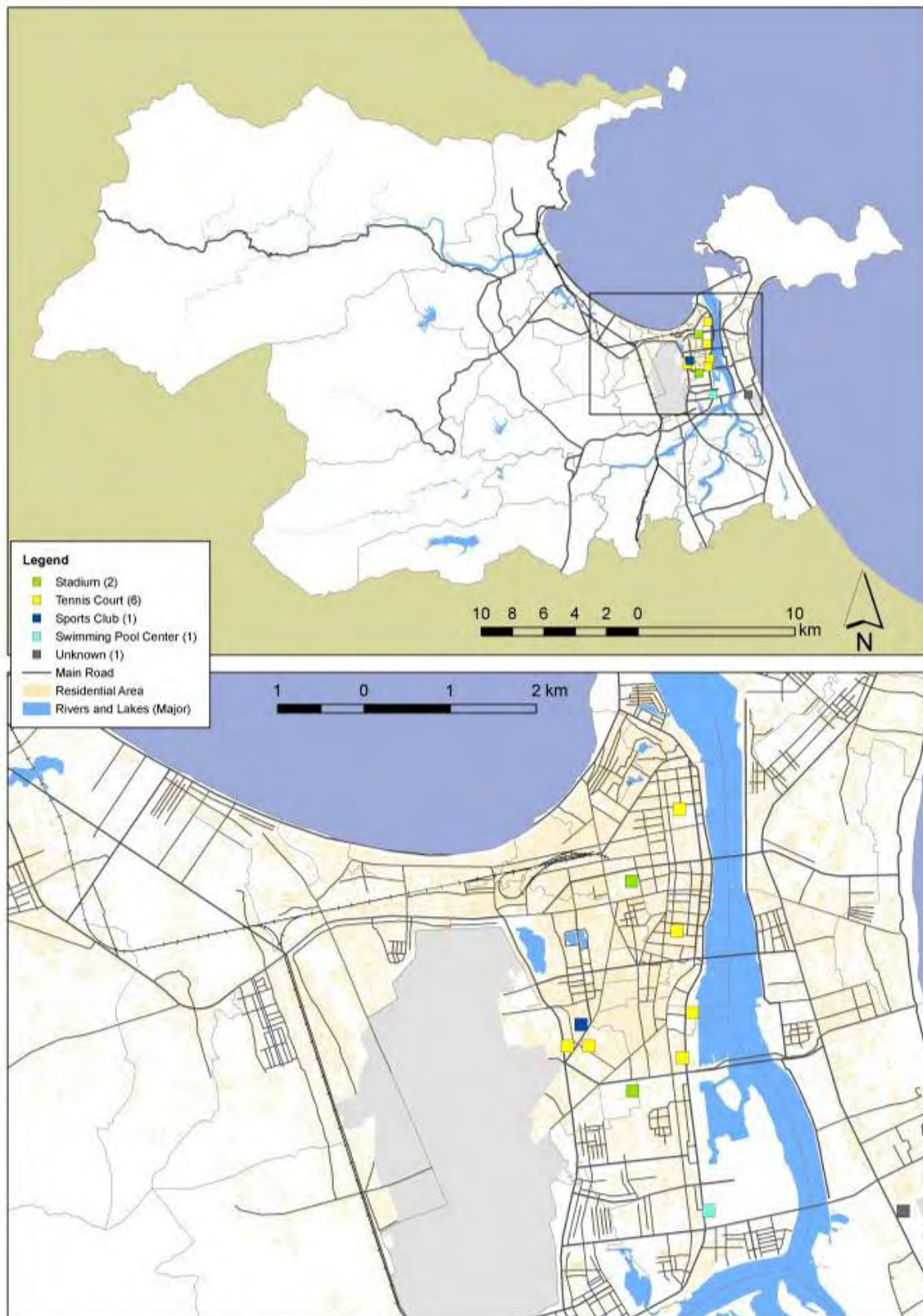
Table 8.5 Cultural and Recreational Facilities in Danang City

Name	Type	Note
1. Vinh Trung Megastar	Cinema	
2. Lotte	Cinema	
3. Fafilm	Cinema	
4. Le Do	Cinema	
5. Cinezen	Cinema	
6. Trung Vuong	Theatre	
7. Nguyen Hien Dinh_Classical Drama	Theatre	
8. General-purpose Performance Center	Theatre	
9. Fair and Exhibition Center	Exhibition Center	
10. Exhibition Center	Exhibition Center	Belongs to the Danang Culture - Information & Exhibition Center --> the same situation with it
11. Dien Hai Citadel	Historical Relic	
12. Bo Ban Communal House	Historical Relic	
13. Nai Nam communal house	Historical Relic	
14. Hai Chau communal house	Historical Relic	
15. Ong Ich Khiem's Tomb	Historical Relic	
16. An Long (Long Thu) Temple Stele	Historical Relic	
17. Qua Giang Communal House	Historical Relic	
18. Tuy Loan Communal House	Historical Relic	
19. Phuoc Ninh Cemetery	Historical Relic	
20. Khue Trung Cemetery	Historical Relic	
21. K20 Historical Relic	Historical Relic	
22. Cham Museum	Museum	
23. Ho Chi Minh Museum	Museum	
24. Historical Museum	Museum	
25. Danang Library	Library	
26. Learning & Information Resource Center	Library	
27. Learning Resource Center	Library	
28. Culture & Sport Center for Old People	Cultural Center	
29. Culture Hall for Children	Cultural Center	
30. Danang Culture - Information & Exhibition Center	Cultural Center	temporarily located at Trung Vuong Theater after it was relocated in 2007 from its site where a 36–50-floor building would be constructed to house commercial centers, hotels, offices for rent. etc.

Source: DaCRISS Study Team, 2009.

3) Sports Facilities

Figure 8.11 Locations of Sports Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

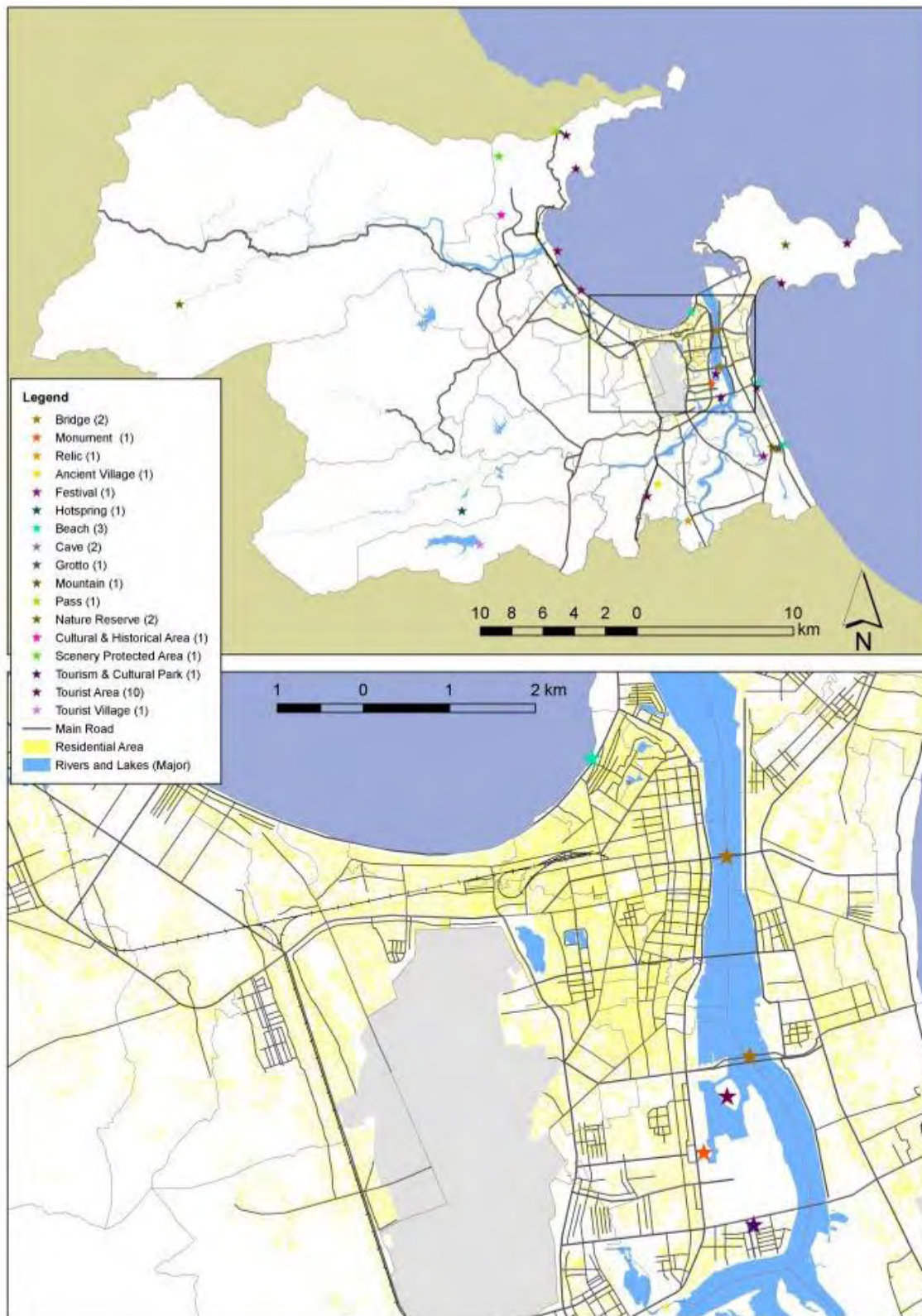
Explanation:

8.18 Facilities related to sports are stadiums, tennis courts, swimming pools, and sport clubs. Two main stadiums in Danang City are the Chi Lang Stadium and the Military Zone No.5 Stadium.

8.19 As the center of the central region, Danang has a high concentration of high-quality training centers for sports and hosts important sports facilities in the central region and Vietnam. Typically, these are National Sports Training Center III, National Defense Sport & Gymnasium Center III, and University of Sports III.

4) Tourism Facilities

Figure 8.12 Locations of Tourism Facilities in Danang City



Source: JICA Tourism Report, 2008.

Explanation:

8.20 Danang is the third largest city in Vietnam. Straddling the Han River, it is located along the coast of the Eastern Sea, with long stretches of beautiful, clean beaches with distinctive attractiveness compared with other coastal cities in Vietnam. Not only is Danang at the crossroads of three World Cultural Heritage sites, but the city has even more unforgettable tourist spots to offer visitors. With the warm hospitality of its people, Danang is a frequent destination of domestic and international tourists.

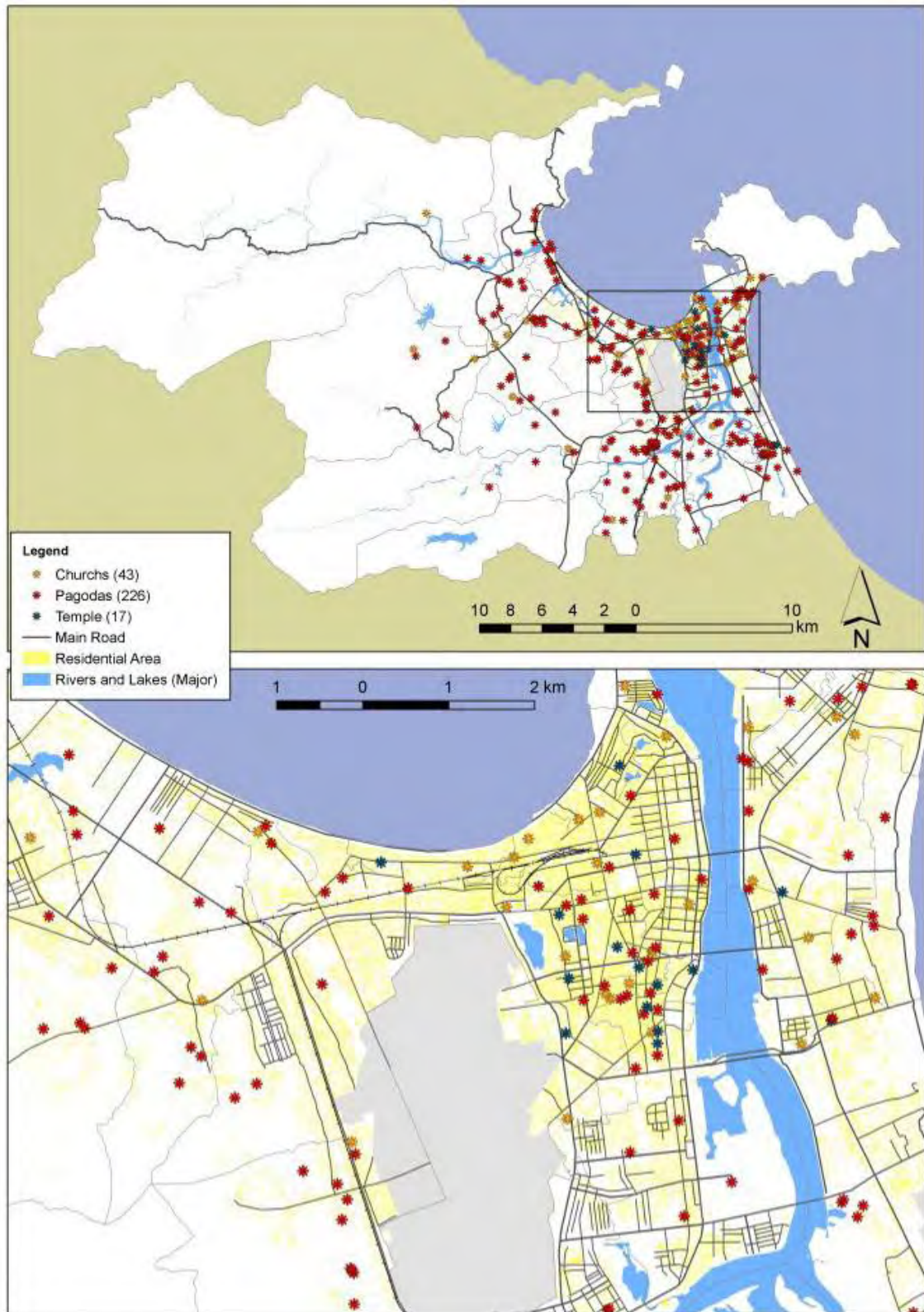
Table 8.6 Tourism Facilities in Danang City

Name	Type
1. Phong Nam Ancient Village	Ancient village
2. Thanh Binh Beach	Beach
3. My Khe Beach	Beach
4. Non Nuoc Beach	Beach
5. Song Han Bridge	Bridge
6. Nguyen Van Troi Bridge	Bridge
7. Van Thong Cave	Cave
8. Hoa Nghiem Cave	Cave
9. Nam Hai Van Cultural and Historical Site	Cultural/ Historical site
10. Quan The Am Festival	Festival
11. Tang Chon Grotto	Grotto
12. Phuoc Nhon Hot Spring	Hot spring
13. 2 September Monument	Monument
14. Marble Mountain	Mountain
15. Son Tra Nature Reserve	Nature reserve
16. Ba Na Nui Chua Nature Reserve	Nature reserve
17. Hai Van Pass	Pass
18. Qua Giang Relic	Relic
19. Nam Hai Van Protected Area	Protected area; scenery
20. Ba Na Tourism Area	Tourism area
21. Da Nang Tourism & Cultural Park	Tourism & cultural park
22. Bai Bac Tourist Area	Tourist area
23. Bac My An Tourist Area	Tourist area
24. Hai Van Tourist Area	Tourist area
25. Xuan Thieu Tourist Area	Tourist area
26. Lang Van Tourist Area	Tourist area
27. Nam O Tourist Area	Tourist area
28. Hai Chau Tourist Area	Tourist area
29. Hoa Cuong Tourist Area	Tourist area
30. Nam Tho Tourist Area	Tourist area
31. Dong Nghe-Phuoc Son Tourist Village	Tourist village

Source: JICA Tourism Report, 2008.

5) Religious Facilities

Figure 8.13 Locations of Religious Facilities in Danang City



Source: 1:10,000 Topographic Map, 2006.

Explanation:

8.21 The locations of religious facilities identified in the map were based on the 2006 topographic map. These facilities consist of churches, pagodas, and temples. Pagodas account for the largest number (226), followed by churches (43) and temples (17). This proves that Buddhism is more popular than Christianity in Danang City.

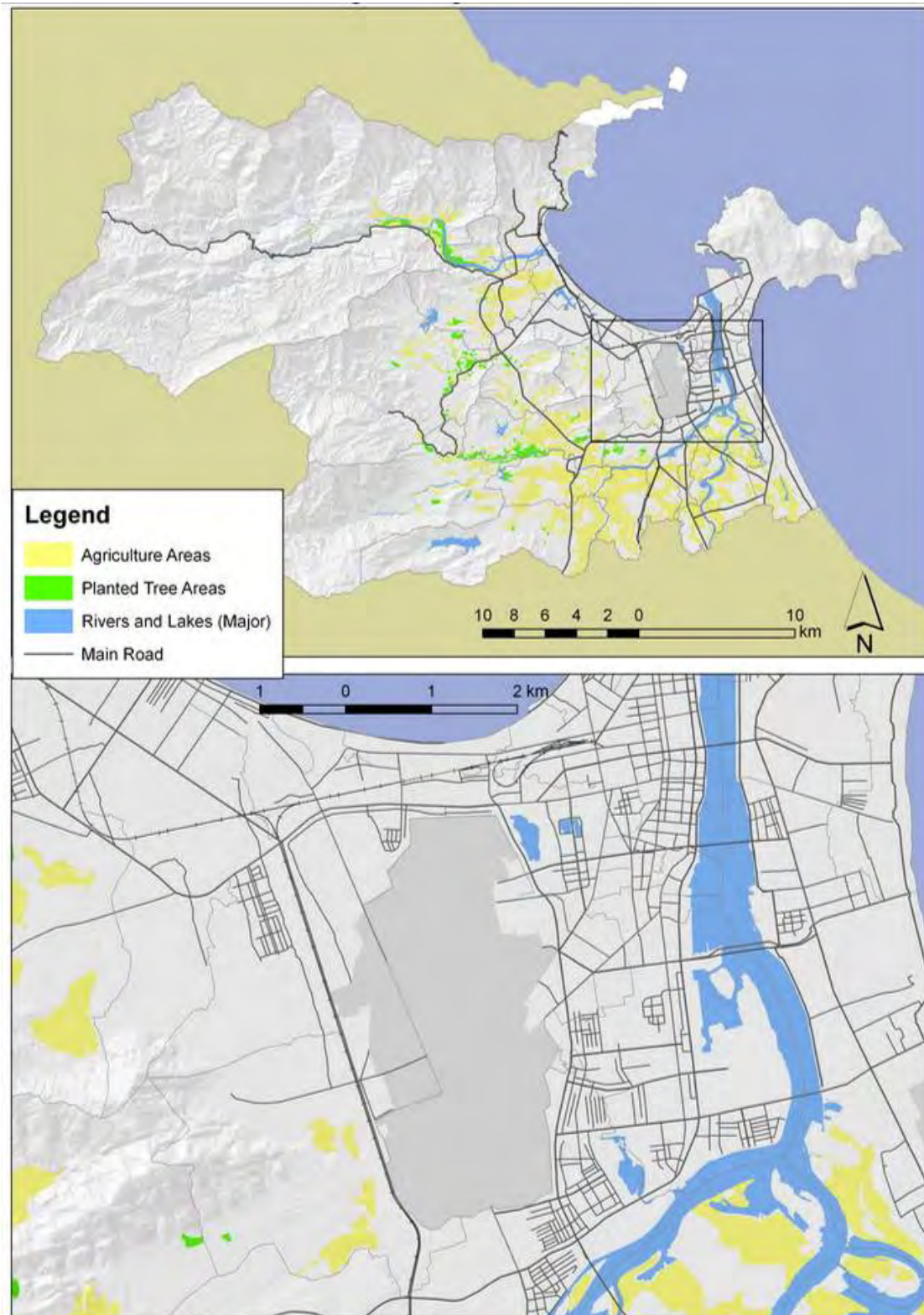
- Pagodas are present in almost all communes in Danang City. However, there are four clusters where pagodas are highly concentrated: Cluster 1 is the area around Tho Quang anchorage near Thuan Phuoc Bridge; Cluster 2 is the wards of Binh Thuan, Binh Hien, and Nam Duong; Cluster 3 is near Cau Do Bridge (communes of Hoa Tho Tay and Hoa Tho Dong); and Cluster 4 is around Ngu Hanh Son Mountain.
- Churches are distributed mainly in Hai Chau and Son Tra districts where many parishioners reside.
- The number of temples in Danang City is not so many. Temples are symbols of traditional beliefs of the local people.

9 ENVIRONMENTAL MANAGEMENT IN DANANG CITY

9.1 Preservation Suitability of Areas

1) Agricultural Preservation Areas

Figure 9.1 Locations of Agricultural Preservation Areas in Danang City



Source: 1:10,000 Topographic Map, 2006.

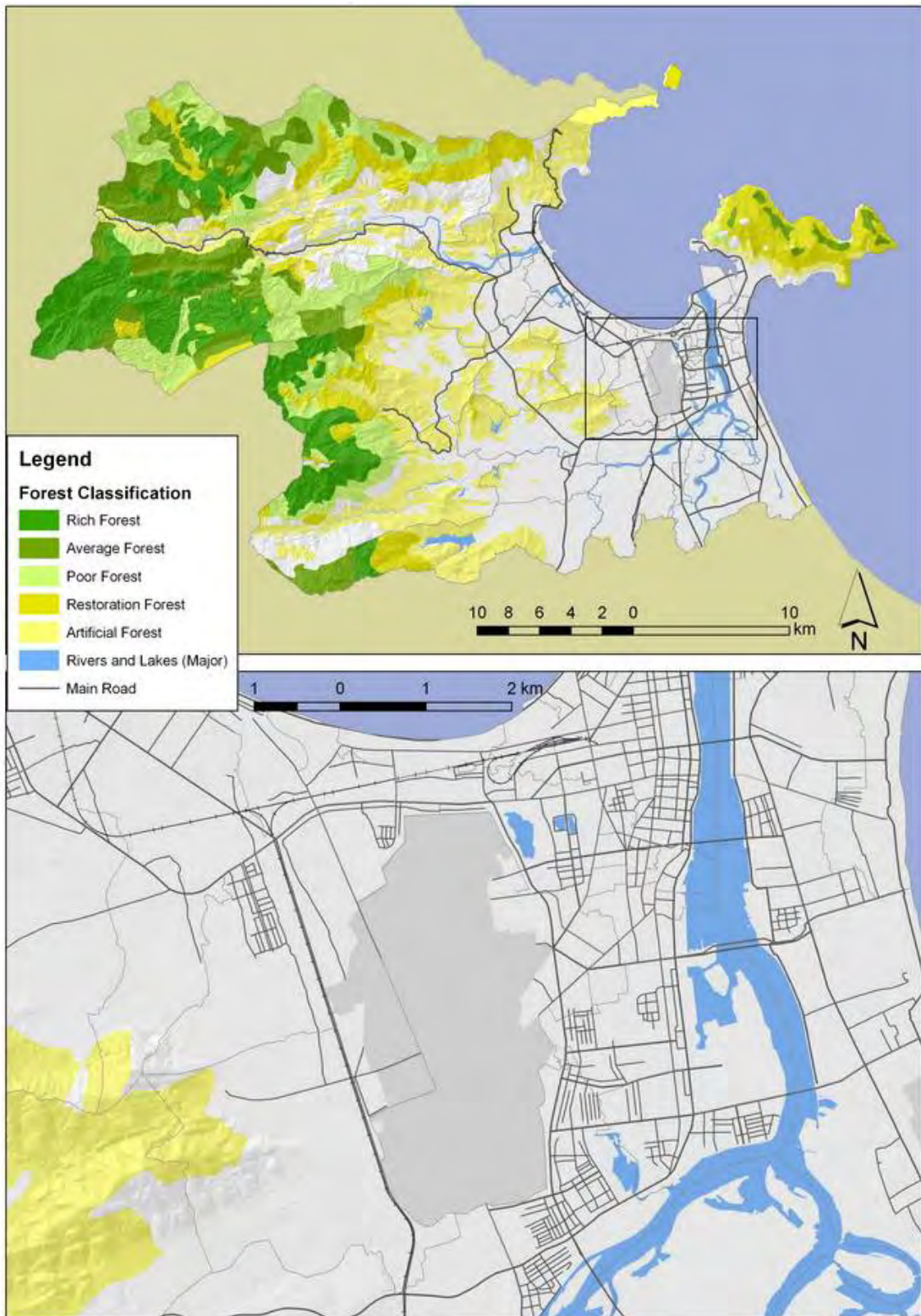
Explanation:

9.1 Identifying preservation areas in Danang City is part of an environmental management strategy and needs to be taken into account when conducting any urban planning.

9.2 Agricultural areas refer to tree farms which cover 814 ha (0.8% of the city's total land area) and other areas for agricultural use such as rice fields, upland fields, orchards, and gardens which cover 8,235 ha (8.4%). These areas are considered highly suitable for any type of land use due to its flat terrain. In Danang City, alluvial lowlands except for the urbanized area are used for agriculture such as rice fields. The future expansion of the present-day urban area will absolutely affect the existing agricultural land. Prime agricultural land with such conditions as excellent soil, flood-free, and with good irrigation system etc., can be evaluated using additional data such as land capability map, irrigation system and natural hazard data. Depending on the accumulated data, a detailed evaluation can be possible in the future.

2) Forest Areas

Figure 9.2 Locations of Protected Forest Areas in Danang City



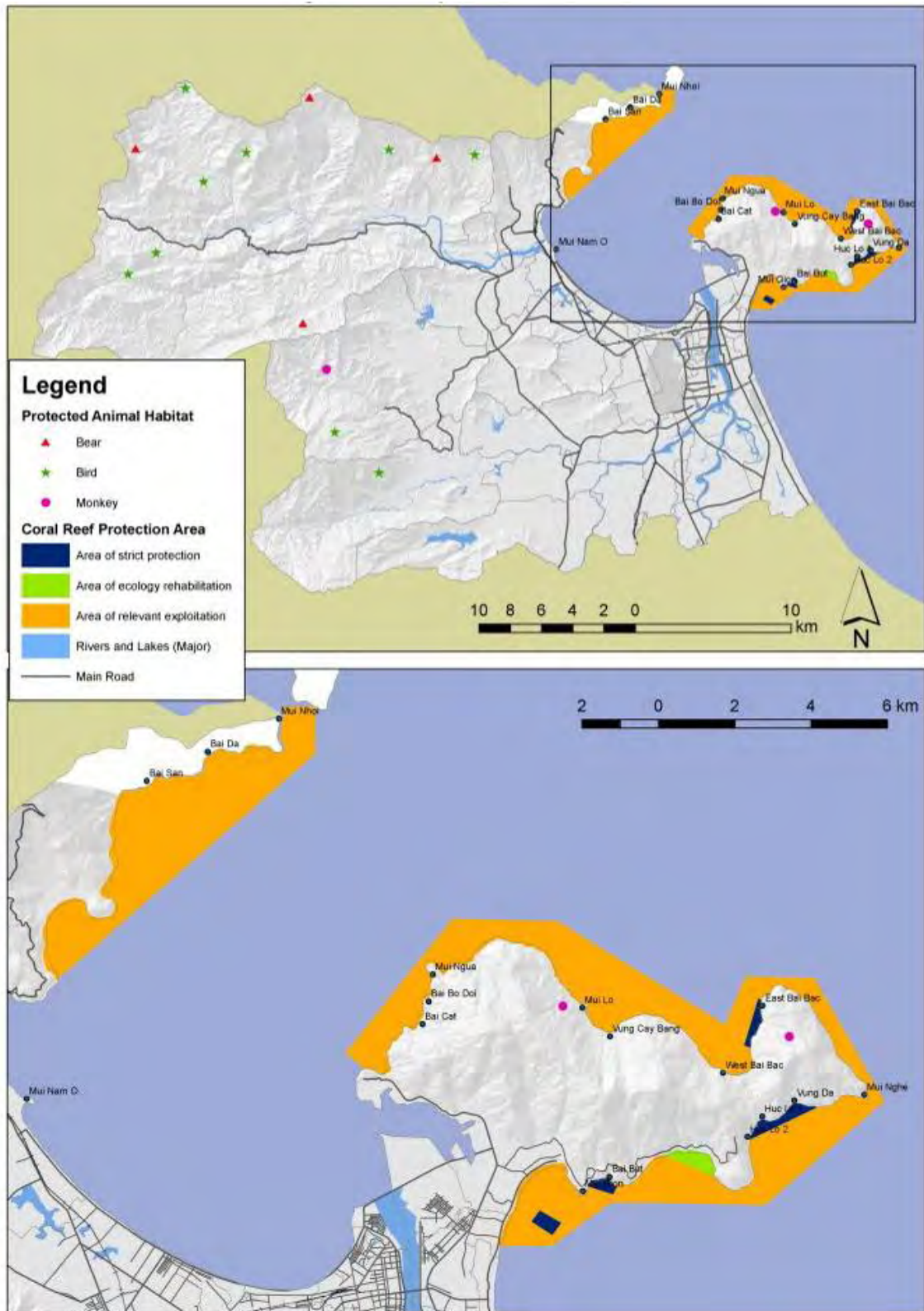
Source: DARD, 2008.

Explanation:

9.3 The database for this map came from the Department of Agriculture and Rural Development (DARD) data in 2008. Forest areas are managed by DARD and are categorized into five classes, namely: (i) dense forest (10,608 ha), (ii) average forest (8,664 ha), (iii) sparse forest (10,640 ha), (iv) restored forest (9,528 ha), and (v) artificial forest (20,608 ha). It is anticipated that forest areas will be developed for recreation or tourism; however, this requires careful consideration to promote ecological balance and manage the watershed.

3) Preservation Areas

Figure 9.3 Locations of Preservation Areas in Danang City



Source: Annual Habitat Information from DARD and Coral Reef Information from DONRE, 2007.

Explanation:

9.4 The areas to be protected due to their ecological importance are classified into two: (i) on sea and (ii) on land. Regarding marine preservation areas, these were defined by the city government as shown in the map and classified into three categories, namely: (i) area of strict protection (core area), (ii) area of ecological rehabilitation, and (iii) area of relevant exploitation.

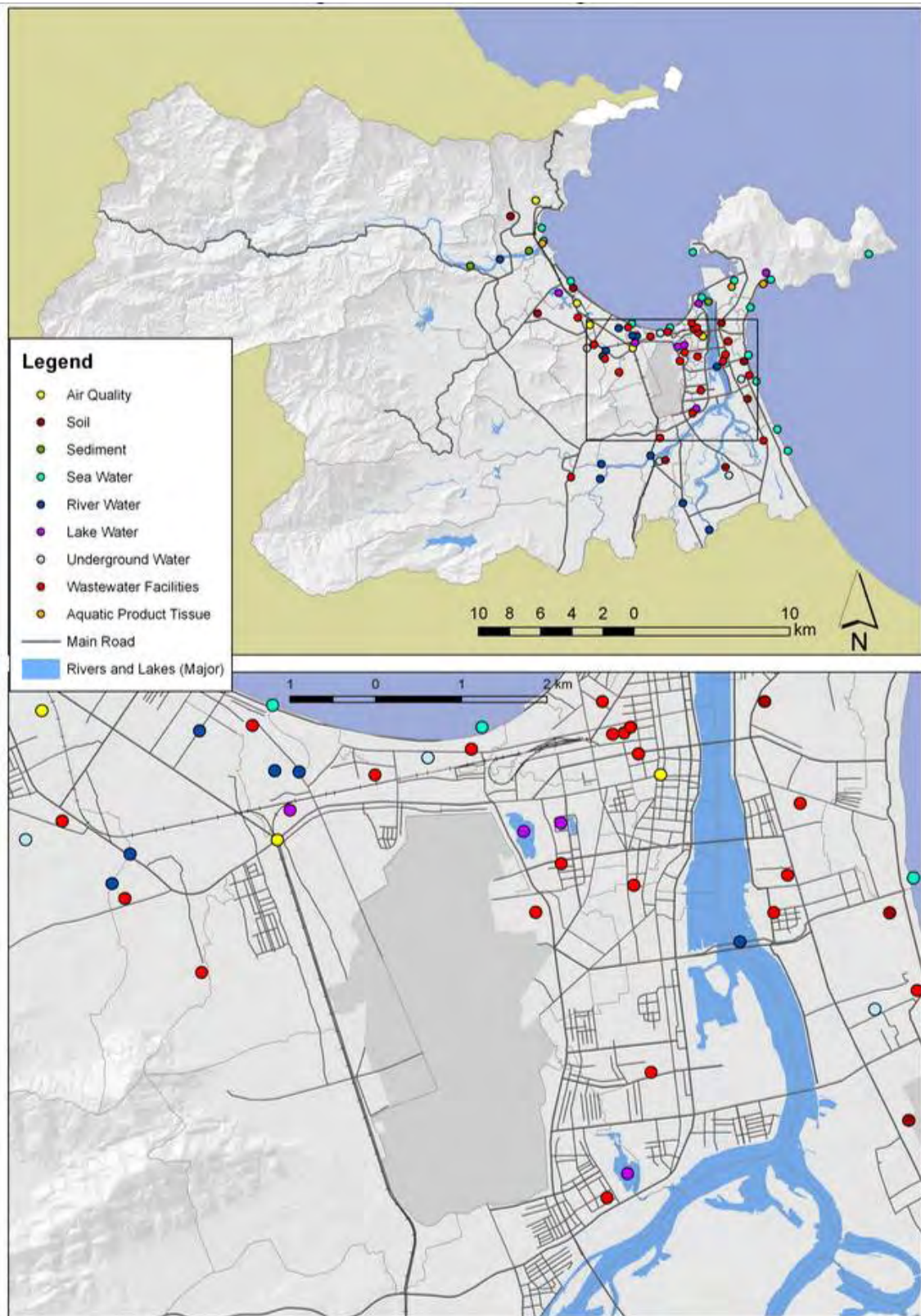
Table 9.1 Profiles of Ecological Preservation Areas

Type of Protection Area	Area (ha)	Definition	Coverage	Banned Activity in the Protection Area
1. Area of Strict Protection (Core area)	82	Territorial waters covering coral reefs and marine ecosystems with high biodiversity, rich flora and fauna that need strict management to maintain its conditions.	Hon Sup, Bai But, Huc Lo, Vung Da, and Dong Bai Bac which is 300 m from the bank to an average depth of 12 m (including 36.2 ha of coral reefs)	<ul style="list-style-type: none"> • Activities regulated in No. 1 and 2 (described below) • Collection of mineral, coral, and microorganism samples
2. Area of Ecological Rehabilitation	48.5	Territorial waters managed, protected, and organized to maintain the quality of ecosystems and existing organisms, and to ensure the recovery of ecosystems, biodiversity, and natural aquatic conditions.	Bai Nom area and 500 m from the bank and the average depth of 15 m.	<ul style="list-style-type: none"> • Activities regulated in No. 1 (described below) • Construction, anchoring, docking ships in coral reefs areas • Exploitation of aquatic products in all methods except for scientific study • Disposal of wastewater
3. Area of Relevant Exploitation (includes Area of Strict Protection and Area of Ecological Rehabilitation)	3,809.5	Territorial waters for aquatic exploitation to ensure the sustainable development of marine resources.	Limited from the shallow near-shore territorial water and deep water from Mui Nhoi to Mui Nam O in the south Hai Van and from Mui Den in the west of Son Tra peninsula to the coastal area of Man Thai precinct, southern Son Tra Peninsula.	<ul style="list-style-type: none"> • Activities damaging the environment, corals, vegetation cover, and other ecosystems; those affecting habitats, breeding areas, and growth rate areas of animals and plants • Use of exploitative, poisonous and other fishing methods to exploit fishery resources. • Exploitation of endangered aquatic products or outside scientific studies (latter should be approved by government), fishery exploitation in sizes smaller than allowed for aquaculture • Aquaculture in industrial scale • Mineral exploitation • Activities causing erosion, coastal sedimentation, and land filling of coral reefs • Encroachment or illegal change in use • Importation of dangerous plants and animals and introduction to local environment, natural ecosystem, diversified biological sea regions. • Activities causing pollution

Source: Decision No. 54/2007/QĐ-UBND, Issuing the regulations on management and preservation of coral reef and eco-system related to territorial area from Chao Island to South Hai Han and Son Tra Peninsula, DPC, September 13, 2007

9.2 Monitoring System

Figure 9.4 Locations of Environmental Monitoring Stations in Danang City



Source: DONRE, 2008.

Explanation:

9.5 Through the data from different sources, such as the Environment Monitoring Report and 10 Years Environmental Status Report from DONRE and data from the Department of Health, the DaCRISS Study Team compiled a map on the locations of monitoring stations. In order to assess the condition of the seas, groundwater, sedimentation, soil, and aquatic resources in various areas in Danang City, a system of environmental monitoring stations was installed.

Table 9.2 Environmental Monitoring Stations in Danang City

Kind of Monitoring Station	Number
Sea water	15
River water	12
Lake water	7
Groundwater	5
Land quality	7
Air quality	11
Sedimentation	3
Aquatic resources	3
Wastewater	24

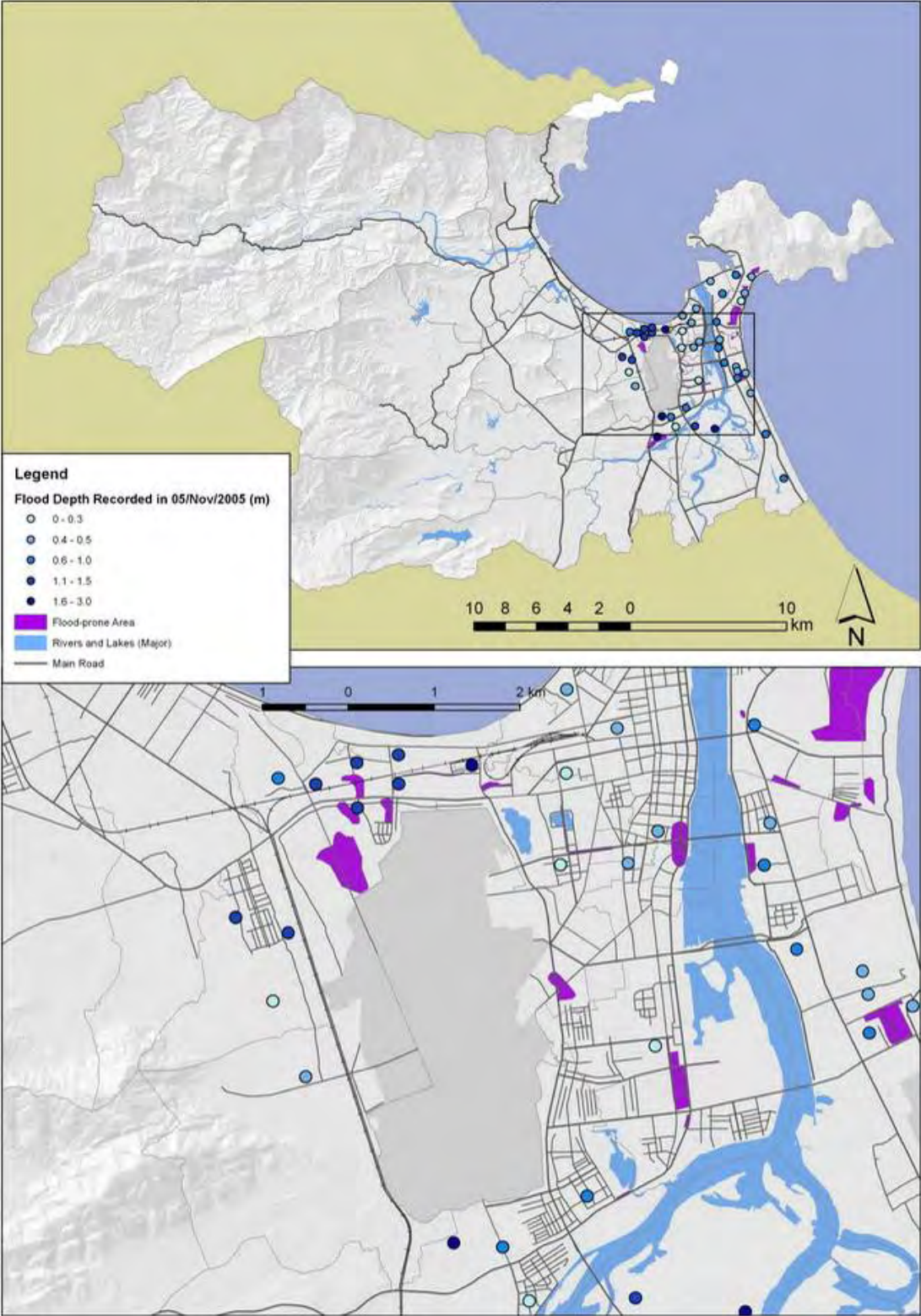
Source: DONRE.

10 NATURAL DISASTER POTENTIAL OF DANANG CITY

10.1 Hazard/Risk Records

1) Flooded and Flood-prone Areas in Danang City

Figure 10.1 Locations of Flooded and Flood-prone Areas in Danang City



Source: PIP 2007, and DOT 2008.

Explanation:

10.1 Danang is located in Central Vietnam which is vulnerable to natural disasters, especially floods and storms, every year. As storms or tropical low pressure areas land on the city, they can cause heavy rains, which trigger flooding in low-lying areas. Additionally, Danang is located in the estuary of Vu Gia River, a large branch of the Vu Gia Thu Bon River basin; therefore, low-lying lands along the river are subject to floods as upstream flows rush quickly down. Flooded and flood-prone sections of urban areas were identified by determining lowlands where water can quickly flow in but difficult to drain rainwater from.

Table 10.1 Flood-prone Areas in Danang City by Commune

District	Commune	Area (ha)	District	Commune	Area (ha)
Hai Chau	Binh Hien	5.2	Thanh Khe	An Khe	5.7
	Binh Thuan	0.0		Chinh Gian	3.0
	Hoa Cuong Nam	9.0		Thanh Khe Dong	3.9
	Hoa Thuan Tay	5.3		Thac Gian	0.9
	Hoa Cuong Bac	2.3		Tan Chinh	0.6
	Nam Duong	1.1		Vinh Trung	1.5
	Phuoc Ninh	3.9		Hoa Khe	23.0
	Thach Thang	0.6		Thanh Khe Tay	0.2
Son Tra	An Hai Bac	33.9	Ngu Hanh Son	My An	13.0
	An Hai Tay	2.7	Cam Le	Hoa Tho Dong	38.8
	Phuoc My	35.7		Khue Trung	0.6
	Tho Quang	24.2			
Total		215.1			

Source: PIP 2007 and DOT 2008

Explanation:

10.2 Flood is the most frequent natural disaster to hit the study area. Based on the data provided by the Committee on Flood and Storm Control of Danang City, flood depths of November 2007 were plotted on this map. Since the data only described floodwater depths by commune unit, each floodwater depth was plotted close to the river channel in their respective communes. In lowland areas, floodwater depths were observed at 1.5–2.2 m.

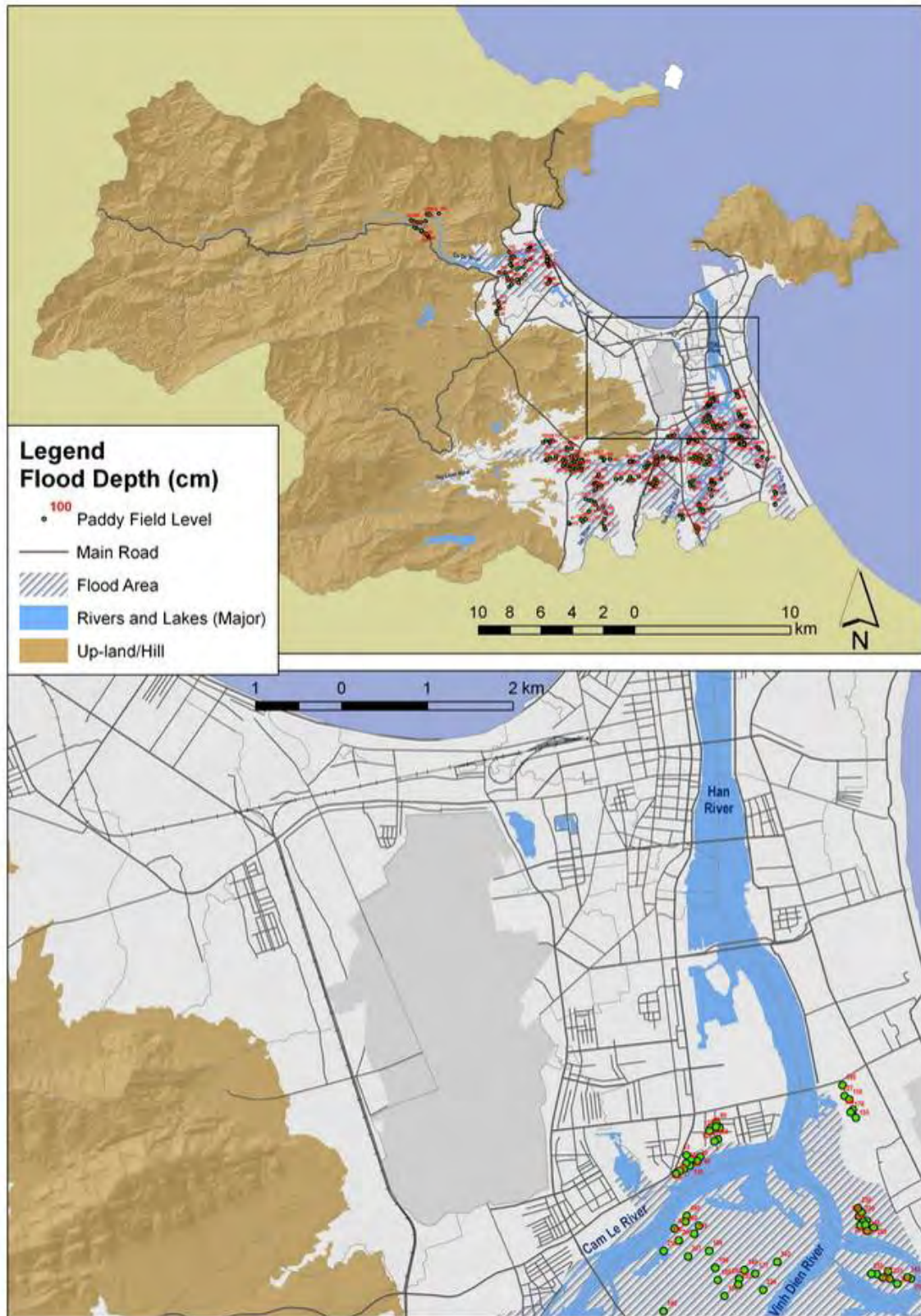
Table 10.2 Floodwater Depths in Danang City by Commune

Commune	Flood Depth (m)
My An	1.5–2.0
Hoa Hai	1.6
Hoa Quy	1.6–1.8
Hoa Xuan	1.7–2.1
Hoa Phuoc	1.4–1.8
Hoa Chau	1.5–2.2
Hoa Tien	1.4–2.1
Hoa Tho Dong	1–1.5
Hoa Tho Tay	1–1.5
Hoa Nhon	1.7
Hoa Phong	1.4–2.1
Hoa Khuong	1.3

Source: Flood and Storm Control Committee, November 2007.

3) Flooded Areas by Typhoon Ketsana in 2009

Figure 10.3 Locations of Flooded Areas in Danang City by Typhoon Ketsana in 2009



Source: DaCRISS Study Team, 2009.

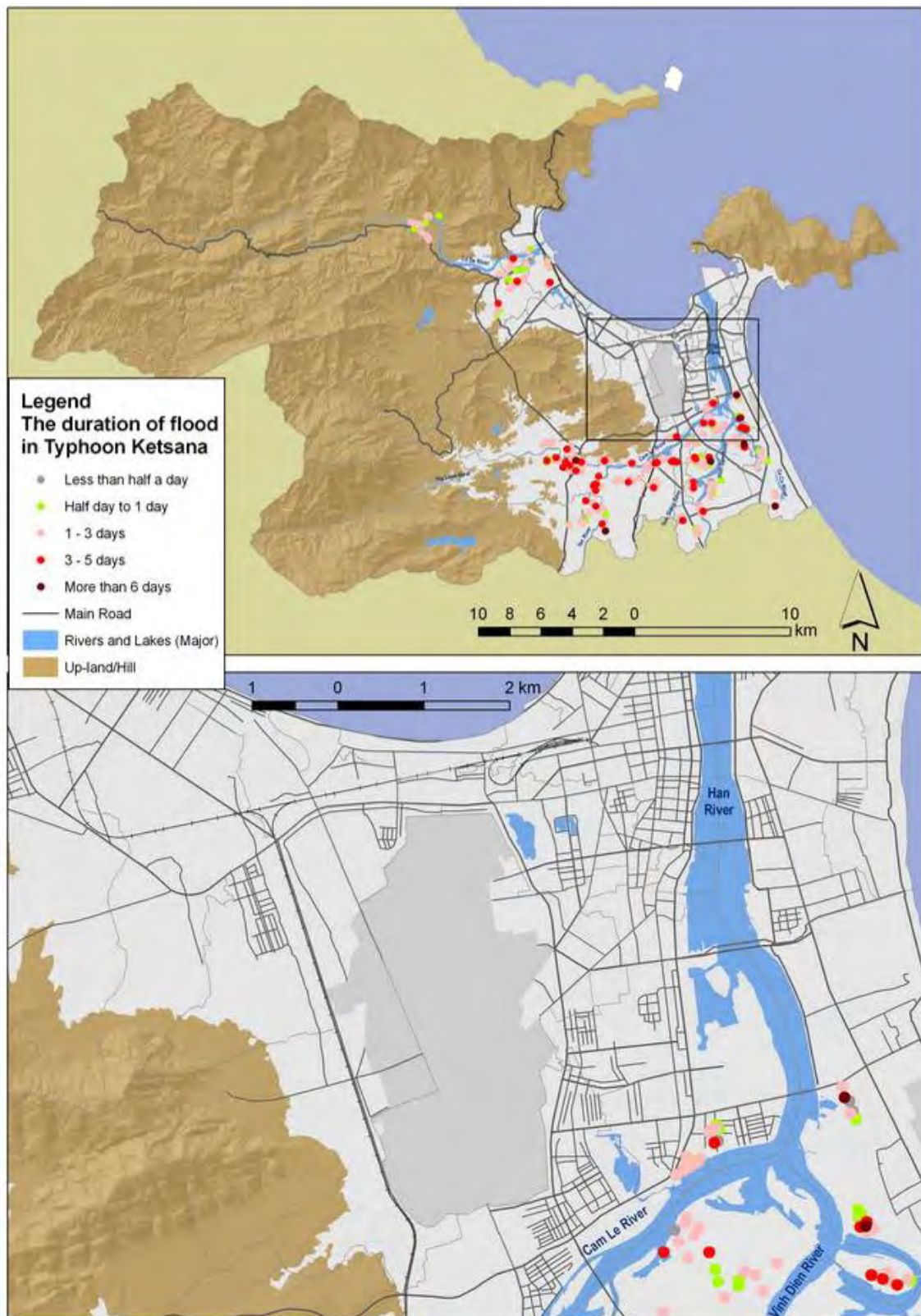
Explanation:

10.3 This map depicts the flood depths experienced during Typhoon Ketsana which landed on Danang and other provinces in Central Vietnam in 2009. The map was created by benchmarking the marks left by the flood still visible in the investigated area through the flood damage survey conducted by the DaCRISS Study Team.

10.4 Ketsana is strong typhoon which occurred in 2009, causing serious flooding in Danang City. The inundated area covered the low-lying lands along the Vu Gia and Cu De rivers. In Vu Gia River, the flooding occurred as a confluence of the Vu Gia and Vinh Dien rivers in the territorial parts of Cam Le, Hoa Vang. The estuary mouth in Nam O was also seriously affected by flooding.

4) Flood Duration during Typhoon Ketsana in 2009

Figure 10.4 Flood Duration in Danang City during Typhoon Ketsana in 2009



Source: DaCRISS Study Team, 2009.

Explanation:

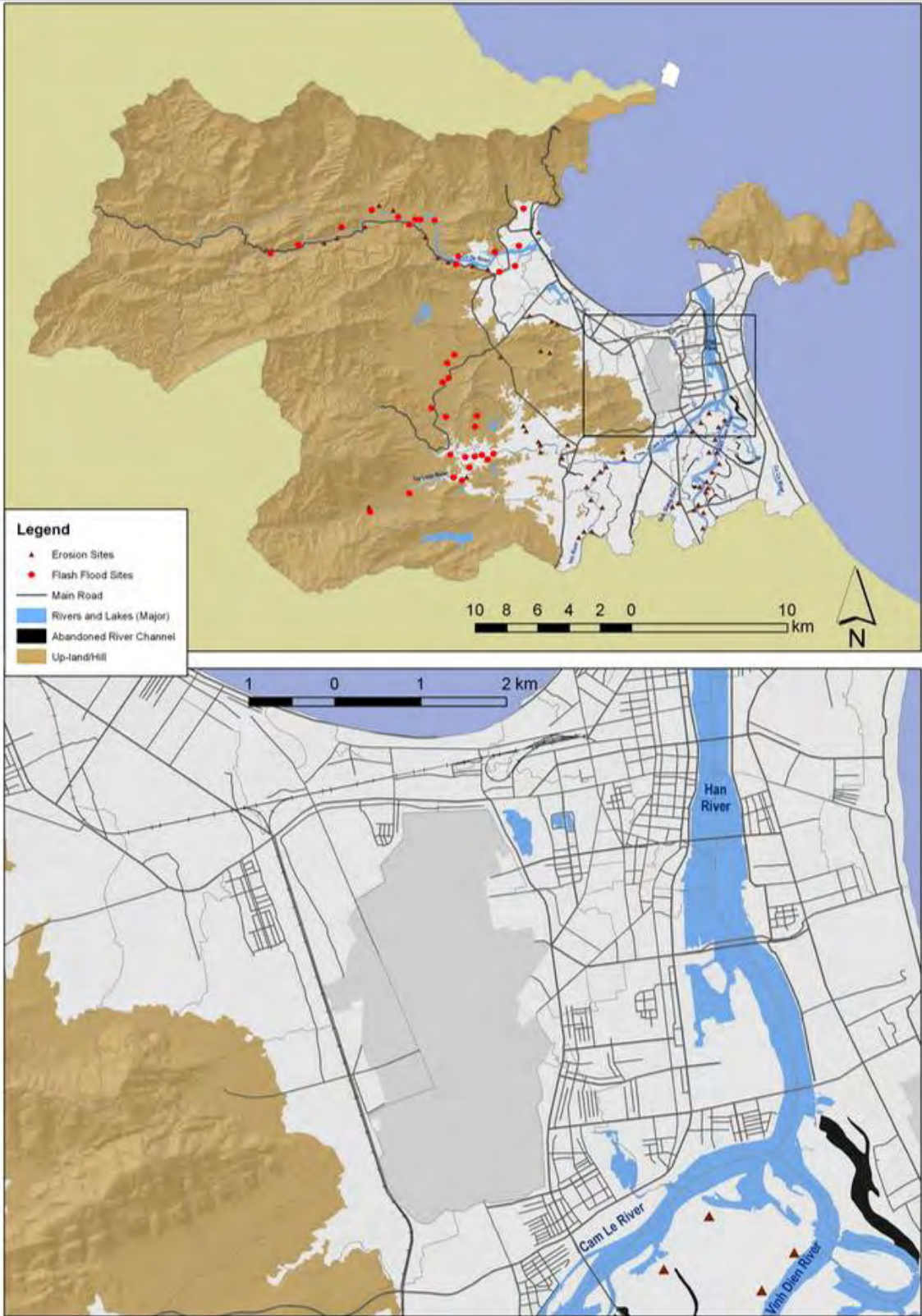
10.5 Accompanying the flood depths map, the flood duration map of Ketsana Typhoon in 2009 in Danang was also created.

10.6 The flood in large areas of the city and caused by Typhoon Ketsana lasted for several days. Those with good storm water drainage systems easily escaped flooding in half a day or a day. However, the depressed areas with weak drainage systems were subject to flooding for several days such as the area's along the Yen and Vinh Dien River. Another reason causing the flood to last for a long time is the continuous flow of water from upstream. Typhoon Ketsana caused rains in large areas not only in Danang City but also in the whole of Quangnam province.

10.2 Development Constraints

1) Locations of River Erosion and Flash Floods

Figure 10.5 Locations of River Erosion and Flash Floods in Danang City



Source: Flood and Storm Control Committee, November 2007.

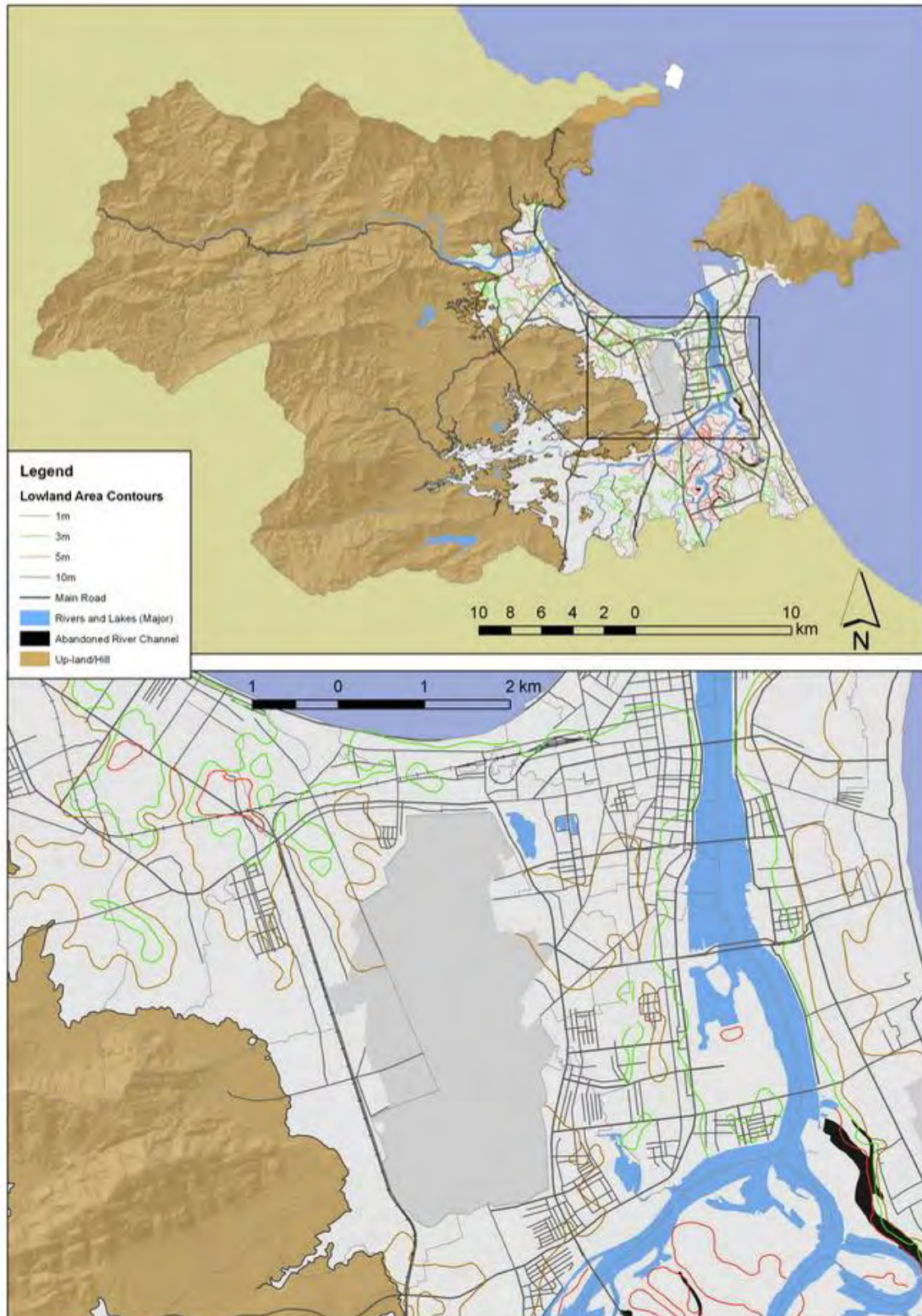
Explanation:

10.7 The data on river erosion and flash floods (in 2007) was provided by the Committee on Flood Control and Storm of Danang City. There are 57 erosion sites and 35 flash flood sites in Danang City.

- River erosion takes place in many points along the main river channels. This phenomenon usually occurs along the banks of big rivers in Southeast Asia which are not protected by artificial dikes.
- Flash flood sites are located relatively upstream of the main rivers. Floodwater flows relatively quick and drains rapidly, too. A large volume of flash flood sometimes causes sizable damage to houses and agricultural crops as well as causes severe surface soil erosion.

2) Lowland Contours

Figure 10.6 Lowland Contours in Danang City



Source: DaCRISS Study Team, 2009.

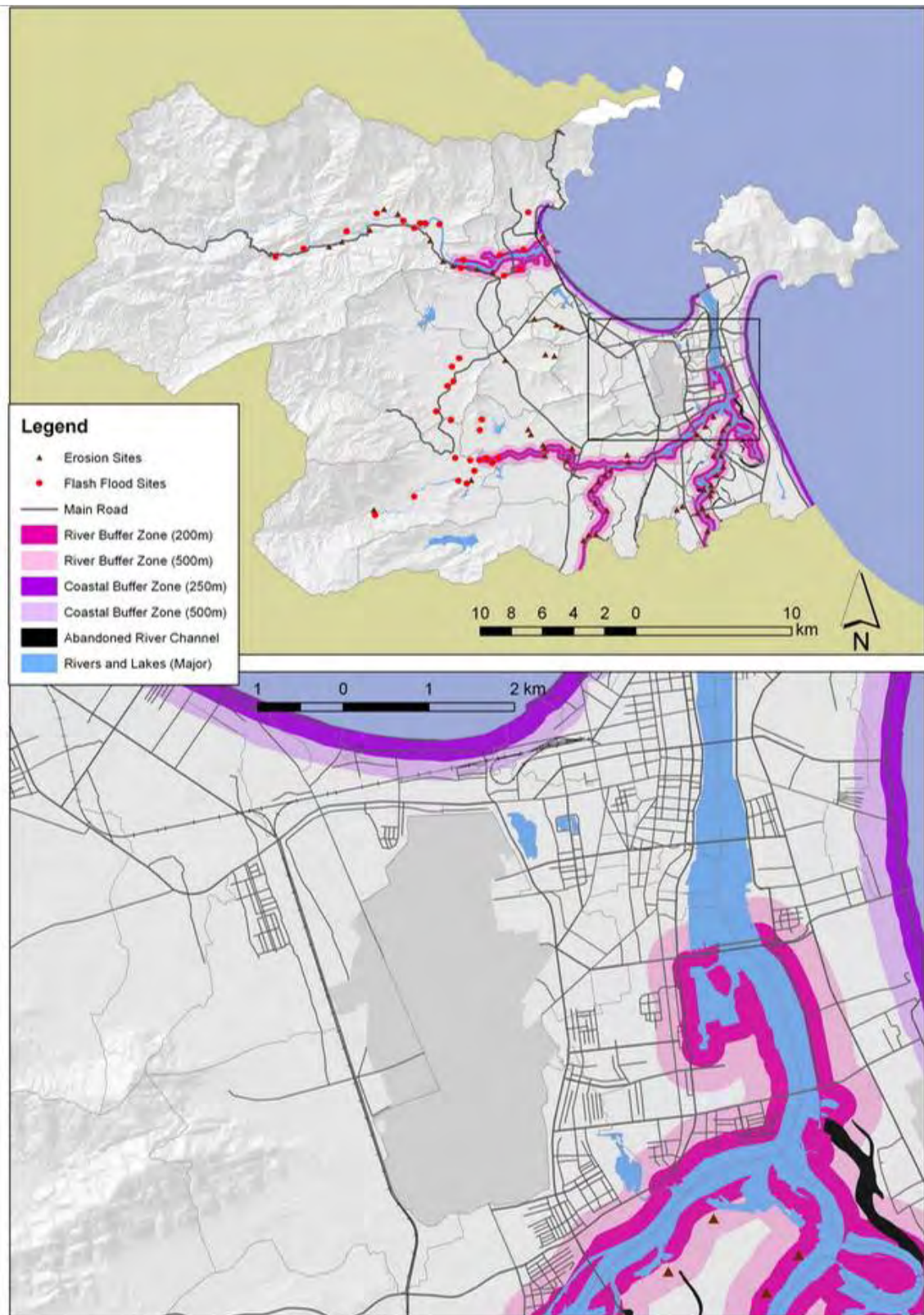
Explanation:

10.8 Alluvial lowland areas in Danang City was formed by active sedimentation by both rivers and coastal currents. Alluvial lowland is composed of very flat land. However, the topographic condition differs according to the type of micro-geomorphology. In order to identify micro-geomorphology of the lowland areas, the area's contours were analyzed based on spot height data. Spot height data were processed using the triangulated irregular network (TIN) software, while contour lines were generated and drawn on the available topographical map. The contours were further edited (smoothing, etc.) based on topographic conditions, as required.

10.9 In this map, detail contour lines such as 1 m, 3 m, 5 m, and 10 m were drawn and compiled to understand relative reliefs and differences in topographical conditions in lowland areas. Based on this lowland contour map, the lowest area with an elevation of 1 m above sea level is located in the lower section of Vu Gia–Thu Bon River basin and along Cu De River estuary. The urban area of Danang City, including its airport and eastern coastal zones, is mostly more than 5 m above sea level. The distribution of lowland contour lines is also indicative of flood vulnerability.

3) Potential Coastal & River Erosion Area

Figure 10.7 Locations of Potential Coastal and River Erosion Areas in Danang City



Source: Flood and Storm Control Committee and DaCRISS Study Team, 2009.

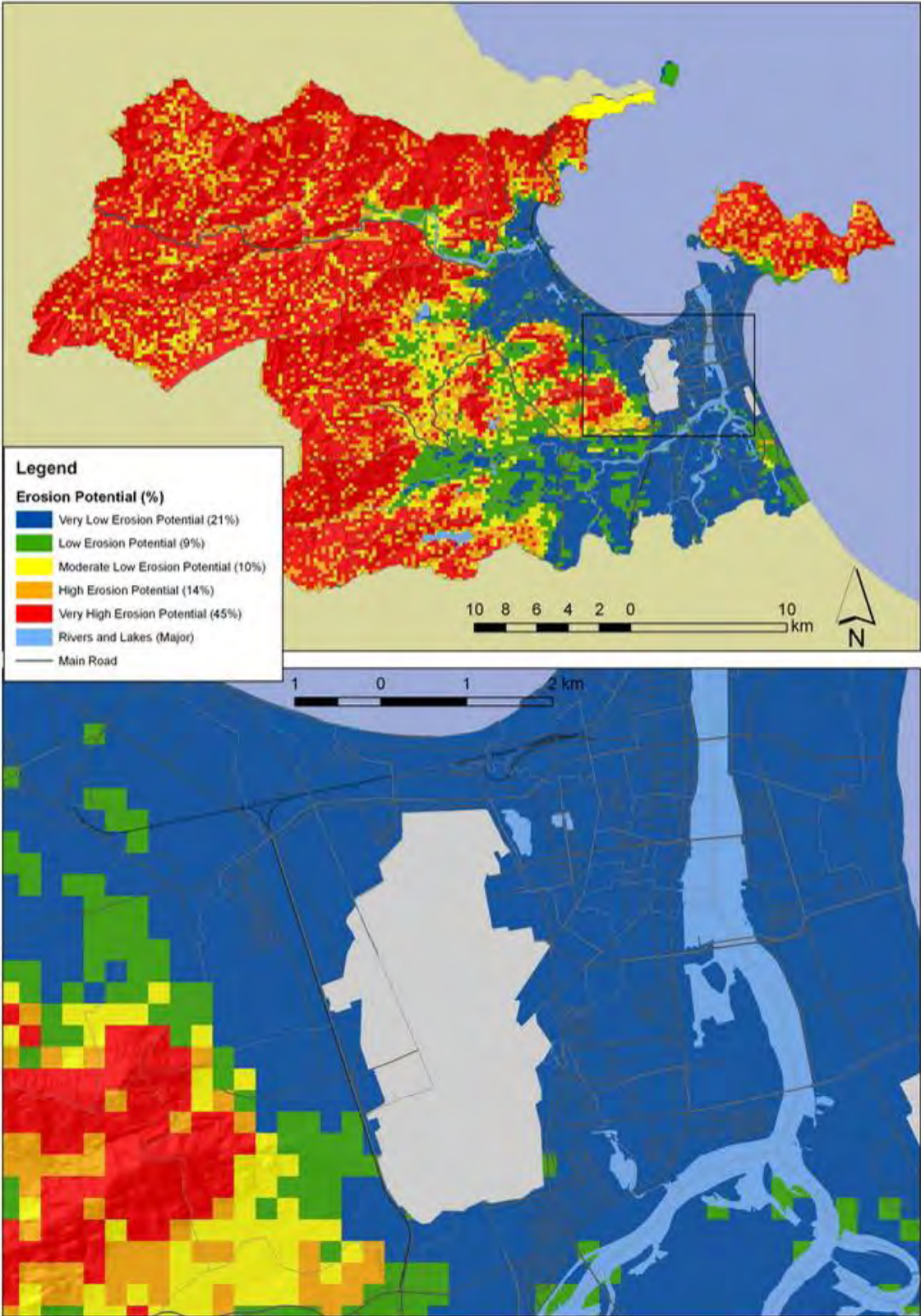
Explanation:

10.10 The waterfront areas in both coastal and riverside need to be considered for coastal erosion and lateral erosion by river flows. To indicate the potential hazard area for erosion, the map shows the buffer areas of 250 m from the coastline and 200 m from the riverbank. Coastal erosion can be caused by changes in the condition of coastal current. Notably, the present coastal landform was formed by the sedimentation carried inland river flows, coastal current and ocean wave activities. It is delicately balanced in the current land form. Therefore, developments which will change the existing river flows and coastal currents should be avoided. In addition, the rise of sea levels due to global warming will affect and change coastal sedimentation. Therefore, the buffer zone was defined tentatively at 250 m from the coastline. Rivers which are not protected by artificial dikes need to be considered for lateral erosion. For this, a buffer zone of 200 m was defined from the river banks. These zones should be carefully managed and considered in development planning.

11 DEVELOPMENT SUITABILITY OF DANANG CITY

11.1 Erosion Potential

Figure 11.1 Erosion Potential of Danang City



Source: DaCRISS Study Team, 2009.

Explanation:

11.1 The potential for surface soil erosion was evaluated by overlaying slope, geologic and vegetation map. In general, the steeper the slope, the higher is the risk for erosion. Vegetation coverage and geological type are also key factors when evaluating soil erosion potential. Slope classes, vegetation types, and rock types are interpreted and given scores to measure the area's susceptibility to surface erosion by run-off (see Table 11.1). For erosion potential analysis, a 250 m x 250 m grid system was developed to cover the whole city. The final map is shaded by five colors to show the erosion potential of Danang City.

Table 11.1 Erosion Potential Analysis Score of Danang City

		0	1	2	3	4	5	6	7
Slope (%)			0–3	3–8	8–18	18–25	25–35	35–50	>50
Geology	First Step	Alluvium	Diluvium	-	Tertiary Mesozoic	-	Paleozoic		
	Second Step	-	-	-	-	-	Granite Schist		
Vegetation		Rice Field, Agriculture, Wetland	-	-	Planted Trees, Forest	Grasslands	Shrubs		

Source: DaCRISS GIS Database.

Table 11.2 Potential Erosion Areas in Danang City

Potential Erosion Area	Area (ha)	%
Very low erosion potential	21,159	21
Low erosion potential	8,729	9
Moderate low erosion potential	9,823	10
High erosion potential	13,812	14
Very high erosion potential	43,688	45
Data not sufficient for analysis	895	1

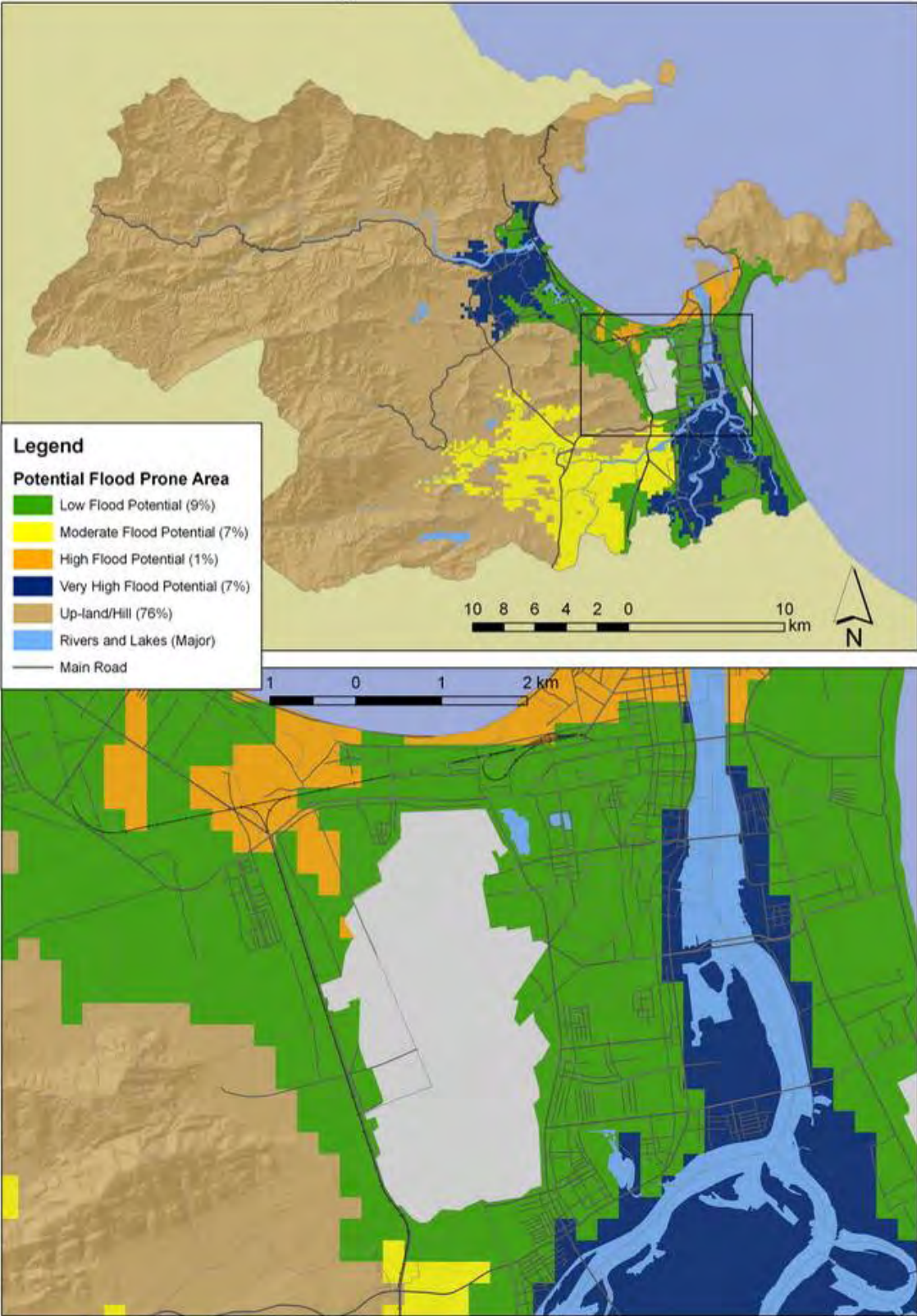
Source: Worked out by DaCRISS Study Team based on DaCRISS GIS.

Note: Percentages are approximate and expressed based on total area of Danang City.

11.2 Thus, almost 45% of the total area of Danang City has very high erosion potential. This is considered one of the major constraints to development.

11.2 Potential Flood-prone Areas

Figure 11.2 Potential Flood-prone Areas in Danang City



Source: DaCRISS Study Team, 2009.

Explanation:

11.3 Since Danang City is located on a low-lying estuary of the Han River flowing in from the watershed covering Quang Nam province, the land in Danang City is prone to flooding in the rainy season. When flooding is caused by heavy rains or high tide, it can be expected that the existing river and the old river channels or wetlands will become flooded as well. Detailed elevation data at 1-meter spot height was collected based on a 1:5,000-scale topographical map. Based on elevation and micro-geomorphologic map, areas with high potential for flooding were identified. If lowland areas are to be developed, flood disaster protection measures should be taken. The distribution of potential flood-prone areas is shown in this map. To develop this map, micro-geomorphological interpretation using satellite images was conducted.

Table 11.3 Potential Flood-prone Areas in Danang City

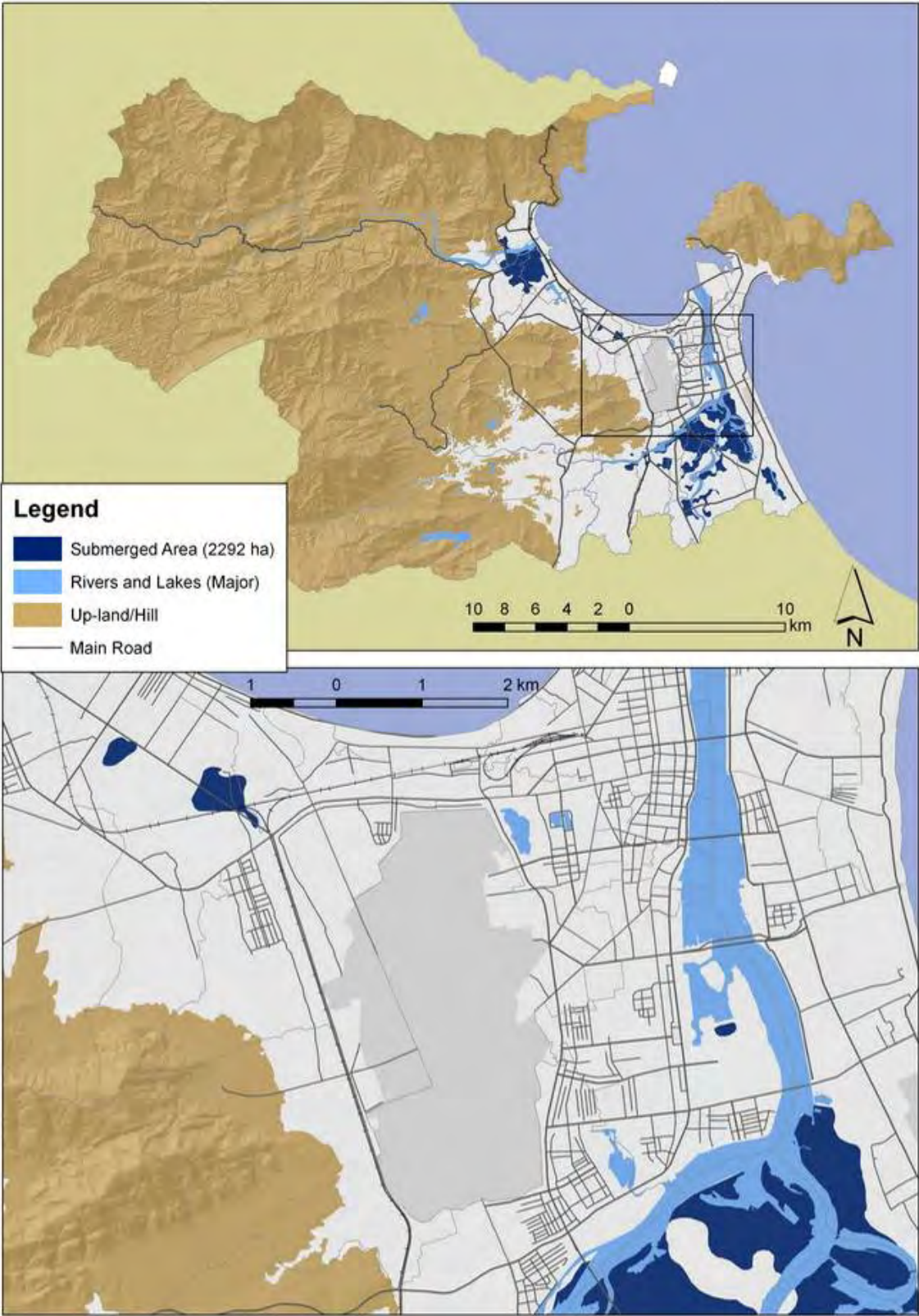
Flood-prone Area	Area (ha)	%
Low flood potential	8,950.5	9
Moderate low flood potential	6,786.5	7
High flood potential	6,786.5	1
Very high flood potential	6,674.7	7
Upland/hill - unsuitable area	74,687.7	76

Source: Worked out by DaCRISS Study Team based on DaCRISS GIS.

Note: Percentages are approximate and expressed based on total area of Danang City.

11.3 Potential Submerged Areas due to 1-meter Sea Level Rise

Figure 11.3 Potential Submerged Areas in Danang City due to 1-meter Sea Level Rise



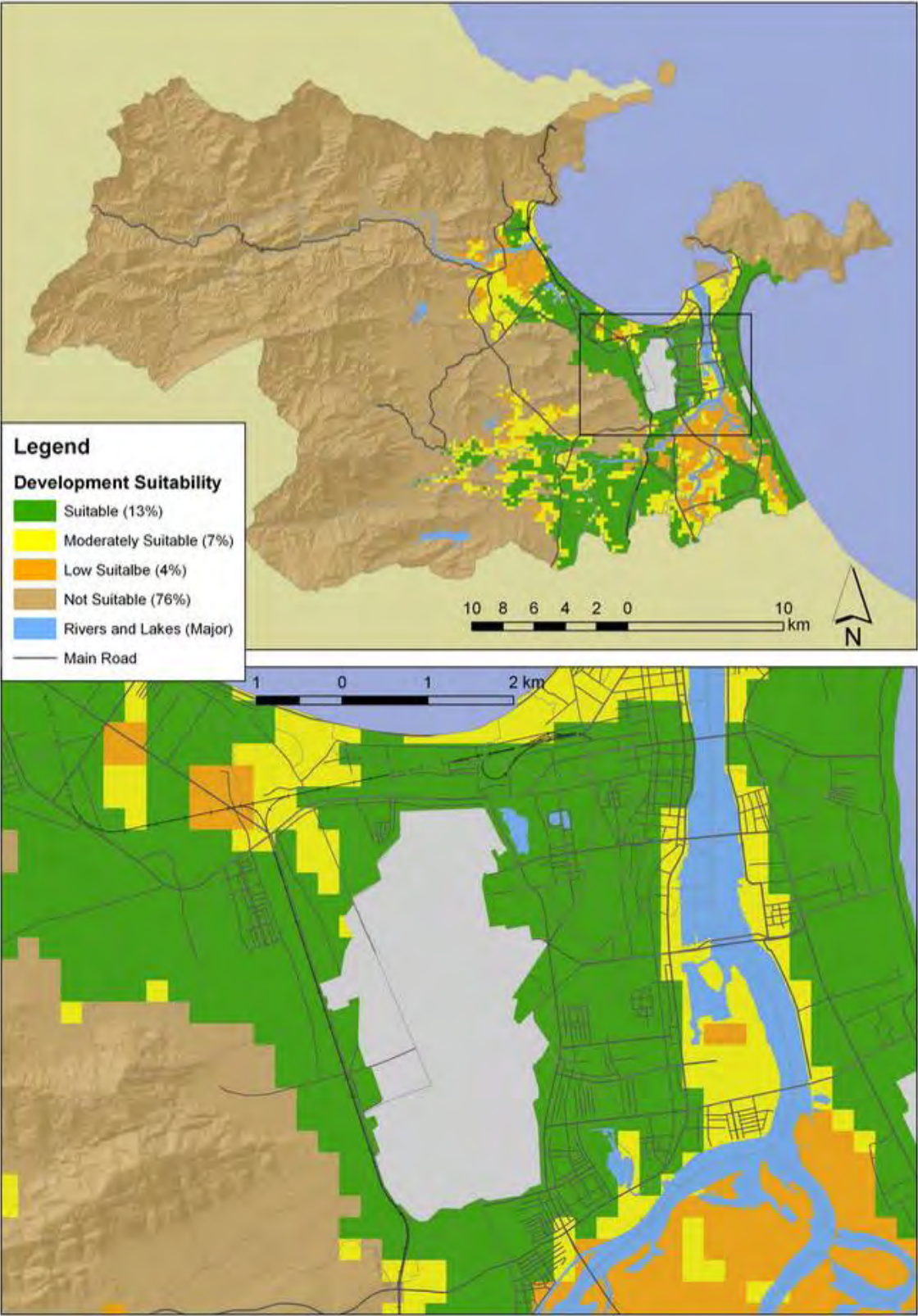
Source: DaCRISS Study Team, 2009.

Explanation:

11.4 Possible seawater intrusion due to rising sea levels as a result of global warming was calculated based on a detailed contour map and the micro-geomorphology of the study area. In this calculation, a 1-meter sea level rise by the end of the 21st century was applied as the maximum value. Results showed that lagoons and lowland areas in the lower reaches of the Cu De River and the deltaic lowland areas of the Han River would be intruded by seawater. The total area with seawater intrusion was estimated to be 2,292 hectares.

11.4 Development Suitability

Figure 11.4 Development Suitability of Danang City



Source: DaCRISS Study Team, 2009.

Explanation:

11.5 About 16,300 grids measuring 250 m x 250 m each were developed to show the study area’s development suitability. Environmental constraints and problematic areas were identified one by one in the secondary data analysis. These data were combined and overlaid on the grid to determine the development suitability of the study area.

11.6 Indicators used for the development suitability analysis were: (i) erosion potential map, (ii) potential flood-prone area map, and (iii) estimated submerged area map. In the study area, topographic conditions, such as flood-free areas, are key factors for evaluating land-use potential. Another indicator used to analyze land-use suitability is erosion potential which is an environmental constraint to development. The modeling table below was constructed based on available data and information given to the Study Team.

Table 11.4 Development Suitability Score of Danang City

(A) Erosion Potential Area	(B) Potential Flood-prone Area	(C) Potential Submerged Area	Development Suitability	Grade (A+B)	Distribution	
					%	km
1–3 => 1	1		Suitable	2–4	13	120
4–7 => 3	3		Moderately Suitable	5–7	6	60
8–10 => 5	4		Low Suitable	8–10	3	33
	(C) Potential Submerged Area		Low Suitable			
11–17	5		Unsuitable		75	718
			River & Lake		2	20
			Total		100	950

Source: DaCRISS GIS Database

11.7 The total area of Danang was then classified according to development suitability by summing up the scores from the erosion potential, potential flood-prone area, and potential submerged area maps. The scores were classified into three categories: (i) suitable, (ii) moderately suitable, (iii) unsuitable. Hilly, upland areas were deemed unsuitable.

11.8 According to this analysis, approximately 13% of the study area or 124 km² is suitable for development. Finally, river and coastal buffer zones should be applied to determine the net suitable areas for development. The map shows the final results of the development suitability analysis.

11.9 It can be observed that most areas in Hoa Vang district and Son Tra peninsula are not suitable for development, as these areas are mostly mountainous. Areas not suitable for development account for 76% of the total area of Danang City. The delta of the Han River has low elevation as seen in the micro-elevation map discussed in this chapter and is flood-prone; therefore, it was rated as unsuitable for development. Most areas suitable or moderately suitable for development which account for up to 20% of the total area in Danang City are already developed in Hai Chau and Thanh Khe districts. Further development in the future will be in Ngu Hanh Son, Cam Le, Lien Chieu, and southern Son Tra districts.

Table 11.5 Criteria for Development Suitability

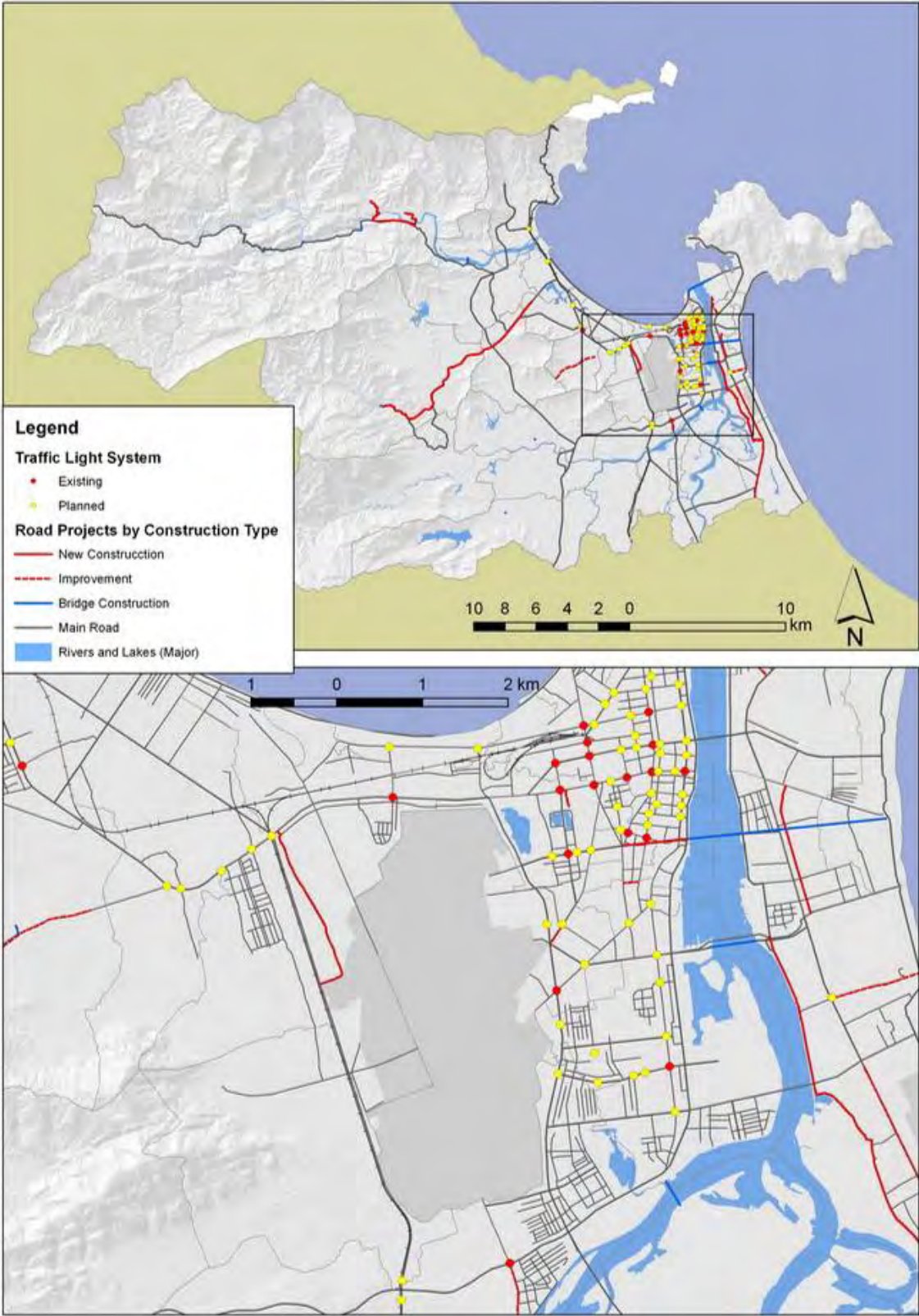
Environmental Zone	Development Suitability	Distribution	
		%	km ²
Development Zone	Suitable	13	124
Transition Zone	Moderately Suitable	7	66
Buffer Zone	Low Suitability	4	38
Preservation Zone	Not Suitable	76	722
-	Total	100	950

Source: DaCRISS Study Team

12 CURRENT MASTER PLAN FOR DANANG CITY

12.1 Ongoing Construction Projects in Danang City

Figure 12.1 Ongoing Construction Projects in Danang City



Source: DOT, 2008.

Explanation:

12.1 In recent years, the economy of Danang City has developed sharply. Urbanization has occurred with high rates, outskirts of urban areas have urbanized. Rural areas are becoming smaller. Urban infrastructure is upgraded and many roads are built. Public transportation is focused on investing. Many bus routes are being set up to connect various parts of the city and the city with Quang Nam province. As shown in the map, all bus routes are located in the western side of Han River, the present-day city center. Hai Chau is the public transportation hub in the city. The planned bus routes will cover new-town areas and the eastern part of the city. This will help locals to move easily from west to east and to other parts of the city as well.

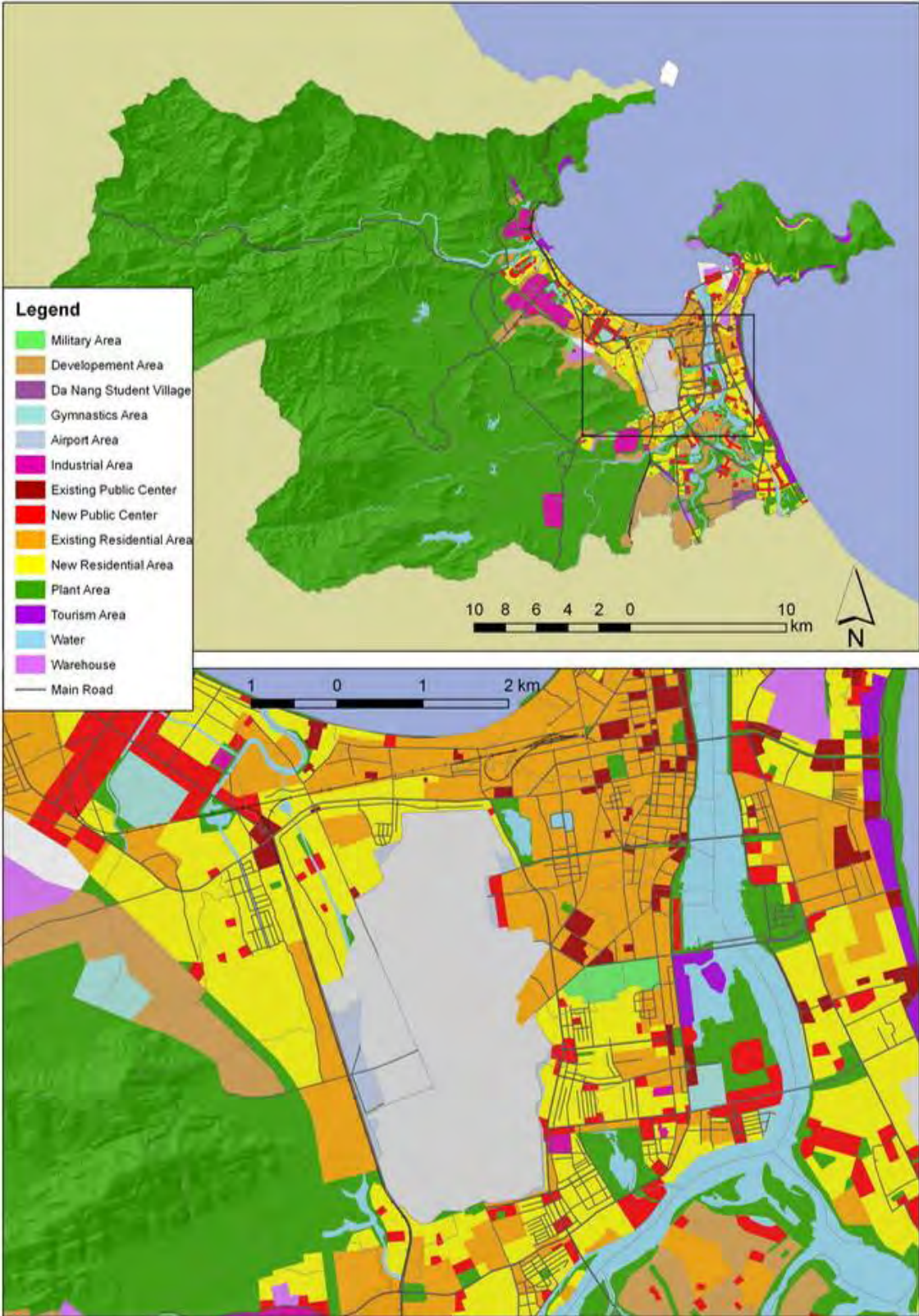
Table 12.1 New Construction Projects in Danang City

New Construction Project	Investor	Location	Category
1. Rong Bridge	DOT	Hai Chau & Son Tra	Bridge
2. New Tran Thi Ly Bridge	DOT	Hai Chau & Son Tra	Bridge
3. Nguyen Van Linh road (be prolonged)	DOT	Hai Chau	Road
4. Danang–Hoi An from Le Van Hien road to Tran Dai Nghia road	DOT	Ngu Hanh Son	Road
5. Hoang Van Thai road (period 2)	DOT	Lien Chieu	Road
6. Hoa Khanh–Suoi Mo road	DOT	Lien Chieu	Road
7. Tran Hung Dao road (be prolonged)	DOT	Ngu Hanh Son	Road
8. Traffic road for cars leading to commune center	Hoa Vang PC	Hoa Vang	Road
9. Support to construct rural traffic road	Hoa Vang PC	Hoa Vang	Road
10. Local Port logistics service	DOT	Son Tra	Port Facility
11. New Hoa Xuan Bridge	DOT	Cam Le	Bridge
12. Bridge over Truong Dinh river	Hoa Vang PC	Hoa Vang	Bridge
13. Ta Lang_Gian Bi Bridge (Hoa Bac)	DOT	Hoa Vang	Bridge
14. Do Quang road (be prolonged)	Thanh Khe PC	Thanh Khe	Road
15. Le Dinh Ly road (be prolonged)	DOT	Hai Chau	Road
16. Nguyen Trung Truc road	DOT	Son Tra	Road
17. Inside_An Hai Dong ward roads	DOT	Son Tra	Road
18. Build Dong Tram bridge (Hoa Nhon)	Hoa Vang PC	Hoa Vang	Bridge
19. Improve and upgrade Ong Ich Duong rd	DOT	Cam Le	Road
20. Traffic Junction Hai Phong–Ong Ich Khiem _Quang Trung	DOT	Hai Chau	Road
21. Drainage ditch of Le Loi road (at section Quang Trung_Le Duan and Pasteur	DOT	Hai Chau	Sewerage
22. Bridge over Phuoc Son village	Hoa Vang PC	Hoa Vang	Bridge
23. Traffic Light at the Song Han bridge (Westen end)	DOT	Hai Chau	Traffic light
24. Drainage pipe system for the area near Tuyen Son bridge (Westen end) and Water Park	DOT	Hai Chau	Sewerage
25. Improve and upgrade Chu Van An rd	DOT	Hai Chau	Road
26. Build Cau Ri Bridge and the road leading to its	Lien Chieu PC	Lien Chieu	Bridge
27. Improve and upgrade Nguyen Phuoc Nguyen	Thanh Khe PC	Thanh Khe	Road
28. Phan Tu rd	NHSON PC	Ngu Hanh Son	Road
29. Road from Nam Yen to CS2_ Vocational Center 05-06	DOT	Hoa Vang	Road

Source: DOT, 2008

12.2 Current DOC Master Plan for Danang City

Figure 12.2 Current DOC Master Plan for Danang City



Source: DOC, 2008

Explanation:

12.2 This is the map of the general plan up to 2020 for Danang City which was developed by Danang's Department of Construction in 2008. The plan for Danang City can be divided in two regions: green space in the west and urban area in the east. Approximately 60% of the total city area is covered by greenery. This green space has an important role in protecting the environment and sustaining the city's development toward the future. Moreover, the urban area is planned in detail with multifunction land uses. Land-use classification in this current general plan for Danang City is shown below.

Table 12.2 Land Uses in the DOC General Plan for Danang City

No.	Zone Name	Area (km ²)
1	Existing Public Center	8.4
2	Industrial Zone	14.8
3	Existing Residential Area	60.7
4	Urbanized Area	13.6
5	Rural Area	9.0
6	Danang Student Village	1.6
7	Military Area	1.5
8	Airport Area	9.1
9	Green Space	53.9
10	Cemetery	1.1
11	Tourist Area	9.9
12	Inland Water Body	14.0
Total		197.6

Source: DOC.

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