PROJECT PROPOSAL

TO ST. VINCENT NATIONAL WILDLIFE REFUGE,
APALACHICOLA, FLORIDA

ASSESSMENT OF THE IMPACT OF ROAD CONSTRUCTION AND OTHER IMPROVEMENTS ON SURFACE WATER FLOW AT ST. VINCENT NATIONAL WILDLIFE REFUGE

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Introduction

St. Vincent National Wildlife Refuge (the Refuge) is owned and operated by the U.S. Fish and Wildlife Service. The Refuge occupies St. Vincent Island, a barrier island that lies just off the coast of Florida, near where the Apalachicola River enters the Gulf of Mexico (fig 1). The island is approximately 9 miles long and 4 miles wide, covering about 12,000 acres. The intent of the Fish and Wildlife Service is to maintain the Refuge in a natural condition. Approximately 80 miles of unpaved roads were constructed prior to the island becoming a refuge. The roads are presently used for managing the Refuge, as hiking trails for visitors, and for law enforcement. The only vehicles allowed on the island are those of the Fish and Wildlife Service.

Problem

Road construction has altered land surface topography on the island, affecting the natural flow of water. The affects of this construction will need to be removed or mitigated to return the flow system to a more natural condition. However, before any restoration work begins, a systematic study is needed to determine the relative affect of each road crossing or structure so that the restoration work can proceed as efficiently as possible.

The natural topography consists of a series of northwest to southeast trending sand ridges that reflect the deposition of sand in dunes. The crests of the dune ridges range from 6 to 12 feet above sea level. Creeks are present in the lowland areas between sand ridges and drain water from the interior of the island to lakes and the Gulf of Mexico. The longer roads run along the sand ridges and generally are parallel to the creeks, while the shorter roads are perpendicular to the ridges and commonly cross the creeks. During road construction, fill was placed in the creek bottoms at the crossings to raise the road bed. The fill affected the natural flow of water in the creeks by: 1) acting as a dam to create surface water impoundments where they naturally did not

occur or were shallower, 2) changing the hydroperiod for some wetland areas, or 3) blocking the natural movement of saltwater up the creeks causing freshwater conditions to develop. The raised road beds range from a few feet in length and relatively shallow to hundreds of feet in length and several feet high. During periods of heavy rainfall, when the storage capacity of the impoundments is exceeded, the flow rate in the creeks would be close to the naturally occurring pre-construction flows. In contrast, during dry periods, when creek flow is derived from aquifer seepage, the new or additional storage capacity created by the road construction could significantly alter flow from natural conditions. Culverts were installed under some roads to allow for drainage.

Hydrogeology

Creek flow on the island is derived from surface runoff and seepage from the surficial aquifer. Recharge to the aquifer is derived from rainfall; and the recharge rate is high due to the high infiltration rate associated with the sandy soils. Because infiltration is high, a significant part of the flow in the creeks (and all of the flow during dry periods) will be derived from storage in the surficial aquifer. A conceptual model of ground-water flow is shown in figure 2. For this model, the permeability of the aquifer is assumed to be relatively homogenous, that is, there are no large permeability contrasts to distort flow in the zone where freshwater is present. Ground water flows from areas of recharge toward the creeks, lakes, or Gulf of Mexico, where it discharges from the aquifer. Water levels depicted in figure 2 were estimated and generalized. Over most of the island the creeks lie between the sand ridges that trend northwest to southeast; the creeks are relatively straight and approximately parallel. The ground-water flow system is divided into several cells by the creeks. The volume of ground water seeping into each creek will depend on the position of the ground-water divides between the creeks. Six lakes occur on the island; water levels in the lakes are controlled to maintain wildlife habitat and to manage certain species of plants.

It would be expected that during periods of high rainfall the volume of freshwater stored in the aquifer would increase due to rising water levels in the aquifer and, more importantly, deepening of the fresh-saltwater interface. During dryer periods, this stored water would provide base flow to the streams.

The subsurface geology and hydrology of the surficial aquifer on St. Vincent Island has not been investigated in the past, and therefore, information is sparse. However, a 1,026-foot-deep well was drilled on St. George Island, immediately adjacent to St. Vincent Island. Due to the close proximity of the two islands, the hydrology and geology should be similar. Notable results of the drilling were: 1) sand from land surface to 75 ft below land surface (bls), 2) hard and soft limestone and dolomite was encountered from 75 ft bls to 1,026 ft bls, 3) brackish water encountered 215 ft bls (14,400 mg/l chloride).

Purpose and Scope

The purpose of this study is to determine the affect of previous road construction on surface water flow. Work will include: 1) a survey of all road crossings that potentially affect water flow, 2) measuring salinity to determine if naturally occurring movement of saltwater up the creeks is being prevented, and 3) ranking each crossing based on the volume of flow that would be expected if the system were functioning naturally. The work will be conducted during a wet period so the affects on surface water flow will be most pronounced.

Survey of road crossings: At each road crossing the following tasks will be done: 1) the affects of the road will be visually inspected and described, 2) the rise of the road surface above the natural channel will be measured using surveying equipment, 3) the average width of the fill will be measured, and 4) the length of the filled area will be measured.

Saltwater intrusion: At some crossings, especially those near the perimeter of the island, the naturally occurring movement of saltwater up the creeks may be prevented by the road fill. This could occur even if culverts are present and would depend on the relative elevations of the

culvert openings and saltwater - freshwater interface. The disruption of the natural movement of saltwater up the creeks will be determined using the following method: 1) a salinity meter will be used to determine the depth to the saltwater - freshwater interface on the seaward side of the crossing, if saltwater is found then, 2) the presence and depth to the interface on the inland side will be determined, and 3) the depth of any culverts present will be measured.

Ranking of each road crossing based on estimated pre-construction flow rate: The expected pre-construction flow rate at each crossing will be calculated using the following method: 1) the contributing area, in square miles, for each creek segment (between road crossings) will be delineated using topographic maps, and 2) the flow rate expected in the creek segment will be estimated by multiplying the contributing area by the unit flow per square mile. The unit flow rate for the island will be determined by: 1) measuring discharges in several creeks that are representative of the island, and 2) dividing the measured discharge rate by the contributing area. The creek discharge measurements will be taken during a period of high baseflow, so the unit flow rate and estimated flows will be at the high end of the natural range. The road crossings will be ranked, from highest to lowest, based on the flows estimated by this method.

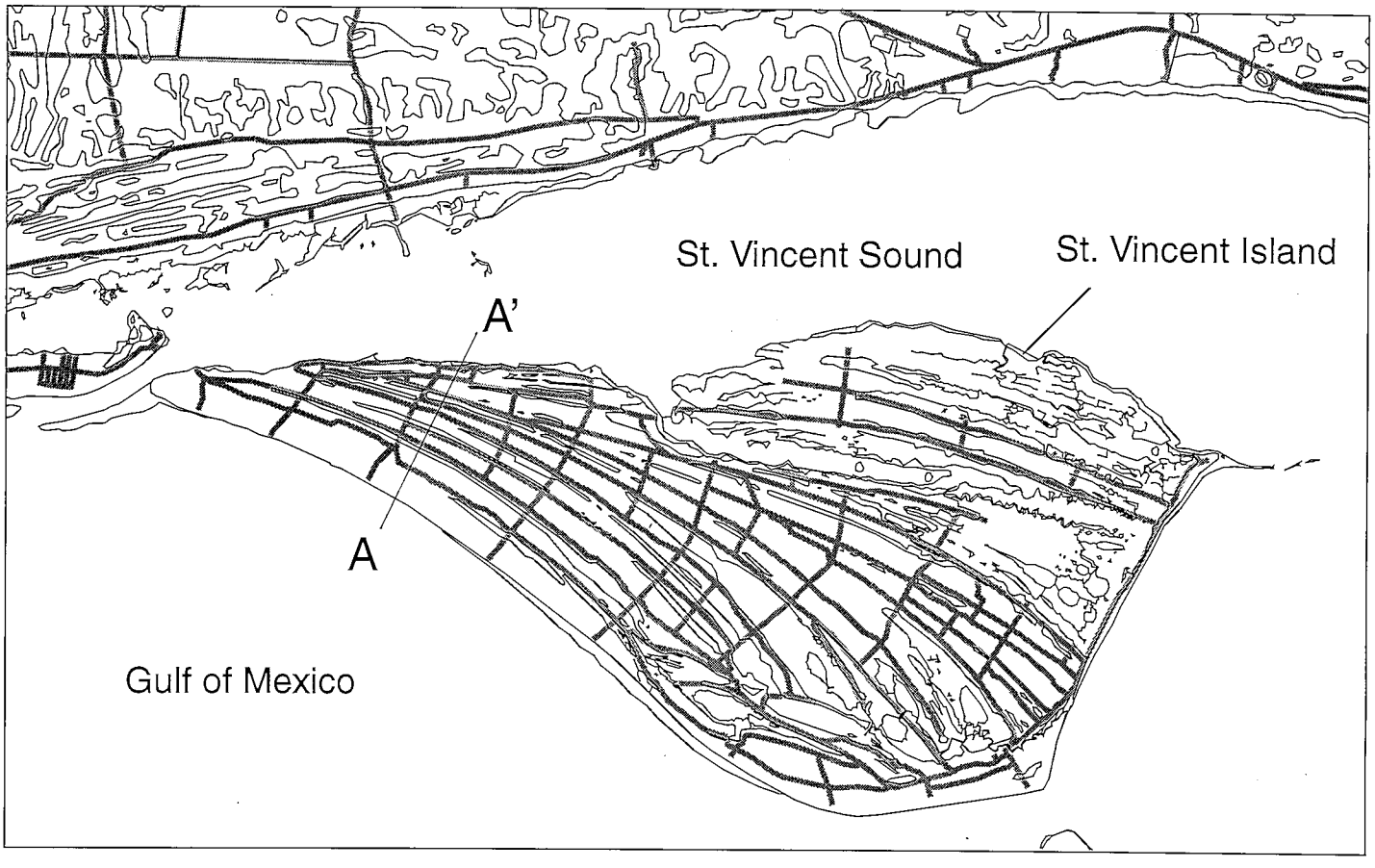
This method will not account for overland flow to the creeks. However, due to the sandy soils on the island, most precipitation infiltrates rapidly into the ground and significant overland flow occurs only during heavy storms. In addition, if it is assumed that the ground-water drainage areas generally correspond to the surface water drainage areas, then the ranking system would still be valid.

Reports

A map report will be published documenting the investigation and results. The report will discuss the physical setting, hydrology, the survey of road crossings, and ranking of road crossings by flow rate. The anticipated layout for the map report is shown in figure 3, however the exact layout will determined at the time of publication.

Table 1: Project Budget:

Person	Position	Costs
GS-12	Hydrologist	11822
GS-12	Geographer	894
GS-11	Publication	6227
GS- 9	Hydrologist	8863
GS - 4	Technical	947
Travel Expenses		1247
TOTAL		30,000



EXPLANATION

ROAD

Figure 1. St. Vincent Island and surrounding area.

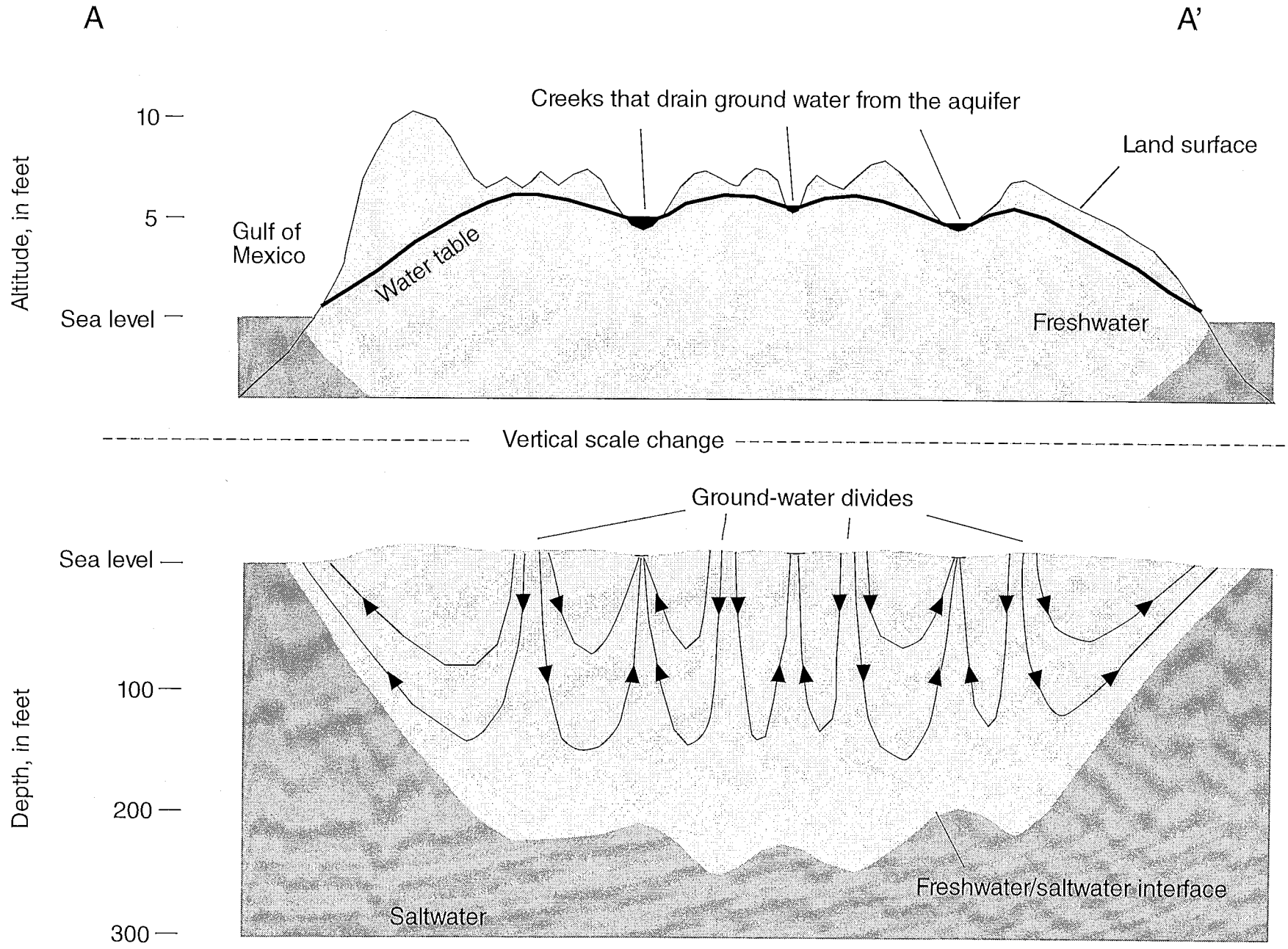


Figure 2. Generalized hydrogeologic section through St. Vincent Island.

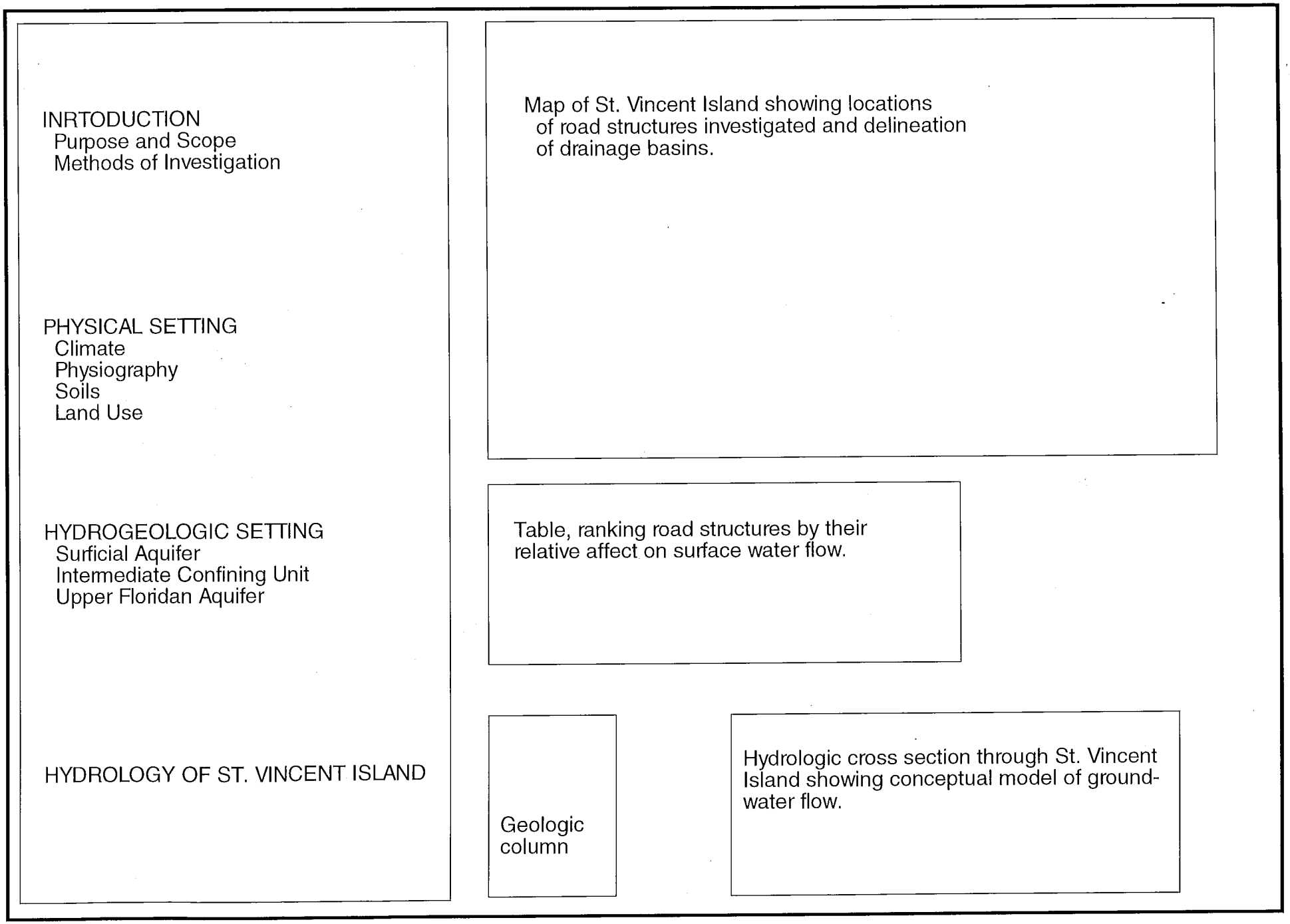


Figure 3. Example of the possible layout of the map report.