A PICTURE OF SPRING PROTECTION-POSTERS IN EDUCATION AND OUTREACH

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Abstract – Florida's springs are a cultural and environmental treasure. The motivation to protect them is widespread. Two posters have been produced at the Florida Geological Survey as part of a spring protection effort led by the Department of Environmental Protection. Both posters have as their focus a large color illustration of a Florida landscape with a cross-section view of the hydrogeology that is associated with the landscape. A spring is a prominent feature of both the landscape and the cross-section. This format was chosen so that the relationship of surface water to groundwater and the subsurface movement of groundwater could be illustrated. Illustration is used in an attempt to overcome the difficulty that non-geoscientists experience in conceptualizing subsurface rock layers and the groundwater resources they contain. *Protecting Florida's Springs* presents fundamental elements of the hydrogeology of springs. *Land Use and Spring Protection* emphasizes a distribution of land use activities that planners expect will provide maximum protection for the spring and was based on the technical illustration, *Overlay Protection District*. Because of their versatility and popular appeal posters remain a valuable part of education and outreach efforts at the Florida Geological Survey.

INTRODUCTION

Florida's springs are a treasured part of the state's environmental heritage. Active citizen involvement in spring protection is essential in Florida, a state where population growth is estimated at 4,000 to 6,000 new permanent residents per week (Morris and Morris, 2001). Springs represent a discharge of groundwater which flows through pore spaces, fractures and conduits in the subsurface. The largely hidden nature of groundwater is one of the primary challenges for designers of products used in education and outreach associated with spring protection. Another difficulty to be considered is that protection of a spring involves protection of groundwater in areas ostensibly remote to the spring. Additionally, the scale of a springshed or spring recharge basin (Copeland, 2003) (on the order of kilometers) defies the use of still photography if an integrated "picture" of spring protection is to be developed. Illustration can be used to assist in the visualization process.

A citizen's understanding of groundwater protection must be based in part on knowledge of the relationship between the surficial expression of common geologic features and the underlying hydrogeology. This sort of intuitive knowledge may be obtained in some areas by everyday observations of rocks exposed in road cuts or more natural settings. Florida, however, is a state that is characterized by low topographic relief (Schmidt, 1997) so that even common features such as layered rocks and fractures are rarely seen. Sinkholes (arguably the state's must common topographic feature) generally contain slump material that obscures their relationship to the underlying limestone.

Illustration is used as an aid in conceptualizing subsurface rock layers and the groundwater resources they contain. The surficial expression of a spring is shown both in its environmental and cultural context (plan view) and in its hydrogeologic context (cross-section view). This juxtaposition of hydrogeologic and environmental/cultural information presents a viewer with the explicit relationship between surficial features (and activities occurring at the earth's surface) and the area's hydrogeology.

Stratigraphy associated with springs was generalized to include three layers. The deepest rock layer shown is limestone. It represents the carbonates of the Floridan aquifer system (Scott, 1992). Limestone layers are shown as pale grey with a light layer of turquoise and the upper surface is irregular to emphasize the effects of karst processes. Turquoise is used to suggest the presence of water in pore spaces in carbonate rocks. Hydrogeologic features were emphasized in rendering the aquifer system. Vertical and horizontal fractures are shown as lines. Enlarged fractures are water-filled and are shown merging with large conduits that produce spring flow. Various

shades of aqua are used to give an impression of water flow through fractures and conduits.

The intermediate confining unit which also functions in some areas as the intermediate aquifer system is shown above the limestone of the Floridan aquifer system. This unit corresponds to the Hawthorn Group, a complex unit characterized by green clays mixed with varying proportions of phosphate, sand and carbonates (Scott, 1992). The intermediate confining unit is shown in green with grey carbonate lenses. A confining unit is essential to the existence of a spring and the intent is to illustrate its complexity and emphasize its importance.

The layer shown above the intermediate confining unit on both posters represents surficial sediments. In much of Florida these sediments contain varying proportions of sand and clay. Locally, where sand predominates, they may serve as a surficial aquifer system (Scott, 1992). These layers were shaded using tones of orange, brown, and yellow to suggest the presence of iron oxides in quartz sand and clay layers.

PROTECTING FLORIDA'S SPRINGS

The poster entitled *Protecting Florida's Springs* (Fig.1) focuses on fundamental elements of the hydrogeology of springs (Bond, 2002a). Text was modified from a previous poster (Florida's Hydrogeologic Environment) that emphasized hydrogeology and the water cycle (Bond, 2002b). Pertinent technical terms were explained in the poster text in light of the educational intent for that product. In the modification process many technical terms were deleted on the advice of a stakeholder who felt strongly that the terminology would provide a barrier to usage for general citizens. That aspect of modification was intensely debated. In the end the stakeholder prevailed. Earth scientists felt strongly that technical terms placed as labels on the drawing enhanced the educational value of the poster. A stakeholder (not a geologist) equated technical terminology with jargon and argued that the message was effectively conveyed by the illustration itself.

In this poster (Fig. 1) a major spring is shown in the context of land use activities commonly associated with urbanization in Florida. The distribution of land usage was not intended to illustrate spring protection efforts but rather to suggest the potential for negative impacts associated with daily activities. This poster has come to be used by presenters with various messages and the depiction of land use with a sort of neutral message has maximized flexibility of this product. Presenters use the illustration as a platform for discussion of spring protection from their individual viewpoints.

The cross-section view is used to relate hydrogeology to activities at the earth's surface (Fig. 1).

Figure 1. The poster, *Protecting Florida's Springs,* uses a cross-section view to relate hydrogeology to activities at the earth's surface.

A sinkhole is shown connecting the earth's surface with the underlying Floridan aquifer system. Recharge is labeled and an arrow indicating its movement into the sinkhole is shown. A municipal landfill is shown related to the stratigraphic and hydrogeologic materials in which it is constructed. An underground storage tank is situated in sediments that make up the surficial aquifer system. It is essential to establish the relationship between the earth's surface which is familiar and it's subsurface which is largely unknown to much of the population who are not earth scientists. Out of sight, out of mind is not an acceptable premise for spring protection.

THE TRANSITION FROM TECHNICAL ILLUSTRATION TO POSTER

Overlay Protection District (Fig. 2) is a technical illustration showing zoning and land use considerations in a springshed (One Thousand Friends of Florida, 2002). The illustration was prepared based on input from individuals in various disciplines involving planning, water resources, agriculture, golf course design, and the environment. Initially two drafts containing the same information were prepared: a map view and an oblique aerial view. A small group of project supervisors, two planners, and two environmentalists chose the oblique aerial view over map view. The oblique aerial view maximizes ease of interpretation while a map view representation is more difficult for many people to understand. The oblique aerial view is also visually pleasing and thus invites readers to take a longer look and (hopefully) absorb more of its content.

The technical illustration was undertaken to give visual substance to planning decisions devised in order to maximize spring protection in the context of an urban area. Although geology was not the focus of this illustration, it was necessary to indicate the relationship of sinkholes to the spring via subsurface conduits. In a karst terrain it is essential to convey the vulnerability of waters flowing through subterranean caves or conduits to pollution. Conduits were indicated by dashed lines with arrows suggesting the direction of water flow. The spring, as the focus of the illustration, was shown at its center. Water flow from it is indicated by line work. The technical illustration was constrained finally both by size and the amount of information that had to be included.

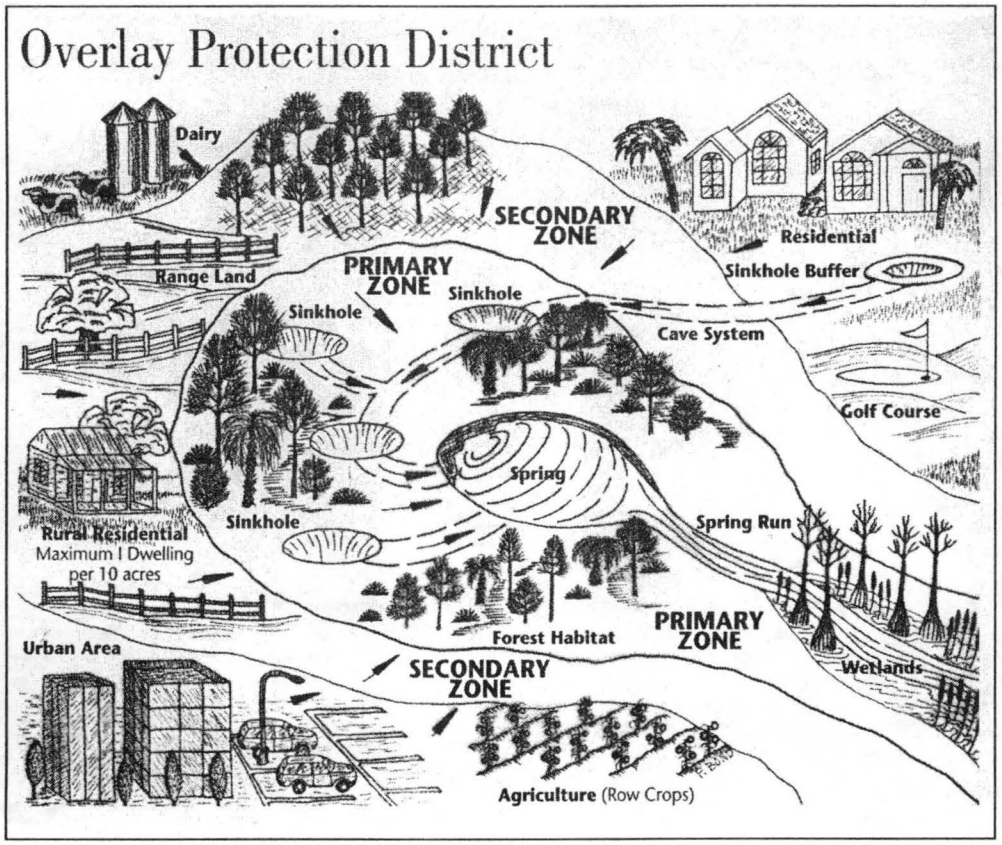

Figure 2. *Overlay Protection District* illustrates zoning and land use considerations in a springshed.

LAND USE AND SPRING PROTECTION

The aim of the poster, *Land Use and Spring Protection* (Fig. 3) was to extract concepts from the technical illustration and adapt them to poster format. Best management practices information was incorporated representing a substantial extension of material presented previously. Land use planning decisions and best management practices information were related to hydrogeology (including a spring) using a cross section view. Poster format allows the use of color and a larger size format to both enhance the visual appeal of the finished product and incorporate additional information.

The poster, *Land Use and Spring Protection,* focuses on a distribution of land use activities that planners hope will provide maximum protection for the spring. Lines separating zones, which appeared on the technical illustration (Fig. 2), were omitted from the poster (Fig. 3) based on input from geologists. The placement of land usages was, however, preserved. Rationale for placement of various land use activities is treated in the short text at the lower part of the poster.

In this illustration a major spring and spring run (a stream that has its origin in a spring (Copeland, 2003)) along with its associated wetlands are shown in their subsurface hydrogeologic context. Sinkholes are also shown scattered around the area. Some are related to the spring by conduits in the cross-section view. Sinkholes are a problematic aspect of the springshed. Pollutants may be introduced directly into the aquifer through them even though they are ostensibly distant from the spring. Three sinkholes are shown in the cross section view to emphasize the manner in which sinkholes may be connected to springs.

Best management practices are pictured in order to emphasize positive roles for individuals, municipalities, and industries in spring protection. Research has shown that land use can result in threats to both the quality and quantity of water flowing from springs (One Thousand Friends of Florida, 2002). It is thought that the poster will be a more effective teaching vehicle if users see themselves pictured as part of the solution rather than the problem.

Figure 3. The poster, *Land Use And Spring Protection,* relates land use planning and best management practices to hydrogeology using a cross-section.

DISCUSSION

Spring protection is the focus of an innovative campaign initiated by the Florida Department of Environmental Protection. Florida's population growth makes citizen education an essential element of the spring protection effort. The low topographic relief that characterizes Florida and the fact that groundwater is a largely unseen resource complicate education efforts. Illustration has been used successfully to show a spring in both its hydrogeologic context using a cross-section view and also in its environmental/cultural context using plan view. An effort has been made to show lithologic units in colors that are fairly realistic to facilitate its use by earth scientists.

The first poster in this series, *Protecting Florida's Springs,* emphasizes general aspects of the hydrogeology of springs. Technical terminology has been kept to a minimum on the advice of stakeholders. Illustration is used to assist in the visualization of hydrogeology and its relation to human activities. Human activities such as mining, agriculture, and waste disposal are typical of what one might see associated with an urban area in Florida. In this poster a brief text explains how spring flow originates and how human activities have the capacity to impact it both positively and negatively. The brief text and the detailed illustration allow for open-ended presentations involving this product.

The second poster in the series, *Land Use and Spring Protection,* had its origin in a technical illustration of a land use plan designed to maximize spring protection in Florida's karst environment. In moving from technical illustration to poster, hydrogeology was added using a cross-section view. Best management practices were illustrated and highlighted in the text in order to emphasize a positive and proactive role for citizens in spring protection. An effort was made using color and design to make both poster illustrations interesting and attractive. It was felt that the message would be conveyed most effectively if users were inclined to linger over the information presented in the poster. Posters are an important part of education and outreach efforts at the Florida Geological Survey. They have been used successfully in presentations to groups of all ages. When mounted on foam-core board, posters are easily used in outreach events held at unconventional venues. A short text with references allows stand-alone use in class rooms, state parks, and municipal and state offices. Digital versions of the illustrations are regularly incorporated into talks allowing the presenter maximum flexibility in commentary. Visually appealing posters that convey clear, positive, and accessible information are a cost-effective means of reaching diverse audiences.

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