Sistema Huautla Cartography Guide

Proyecto Espelelógico Sistema Huautla (PESH); updated May 17, 2015 by Derek Bristol

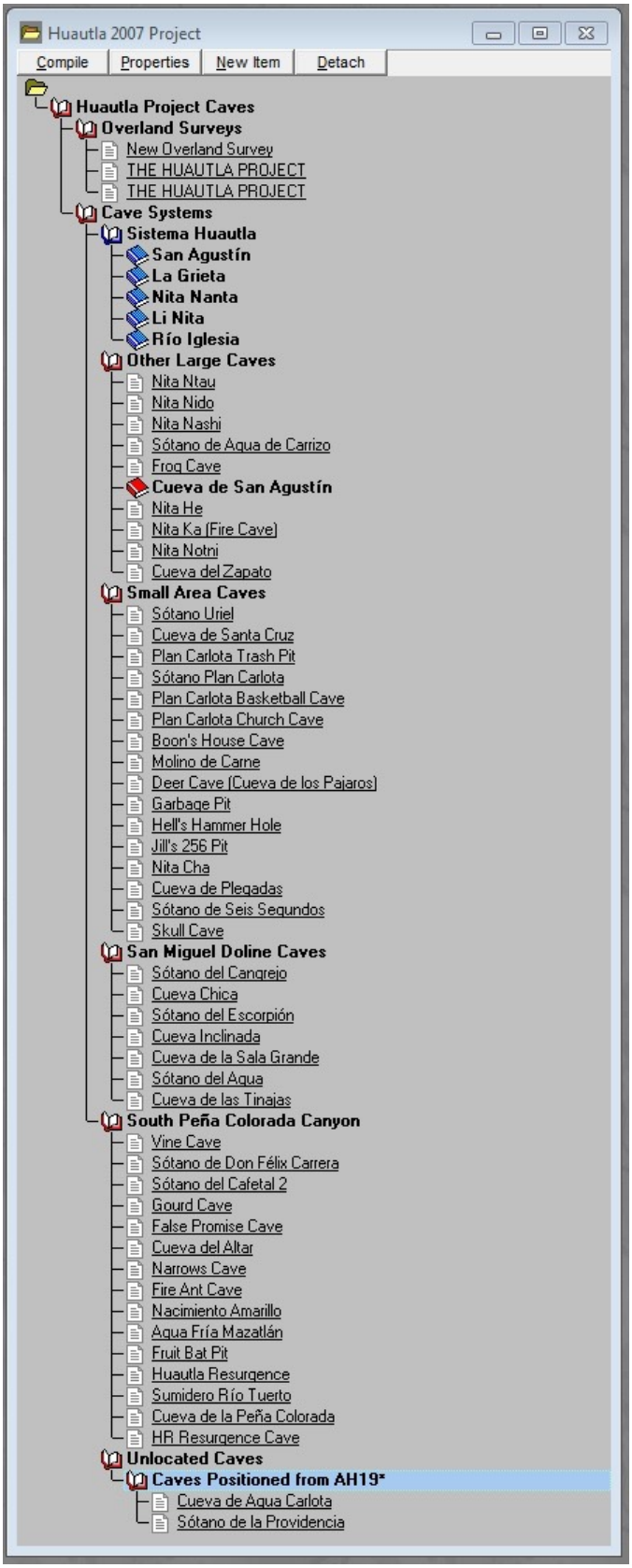
Background and Objective

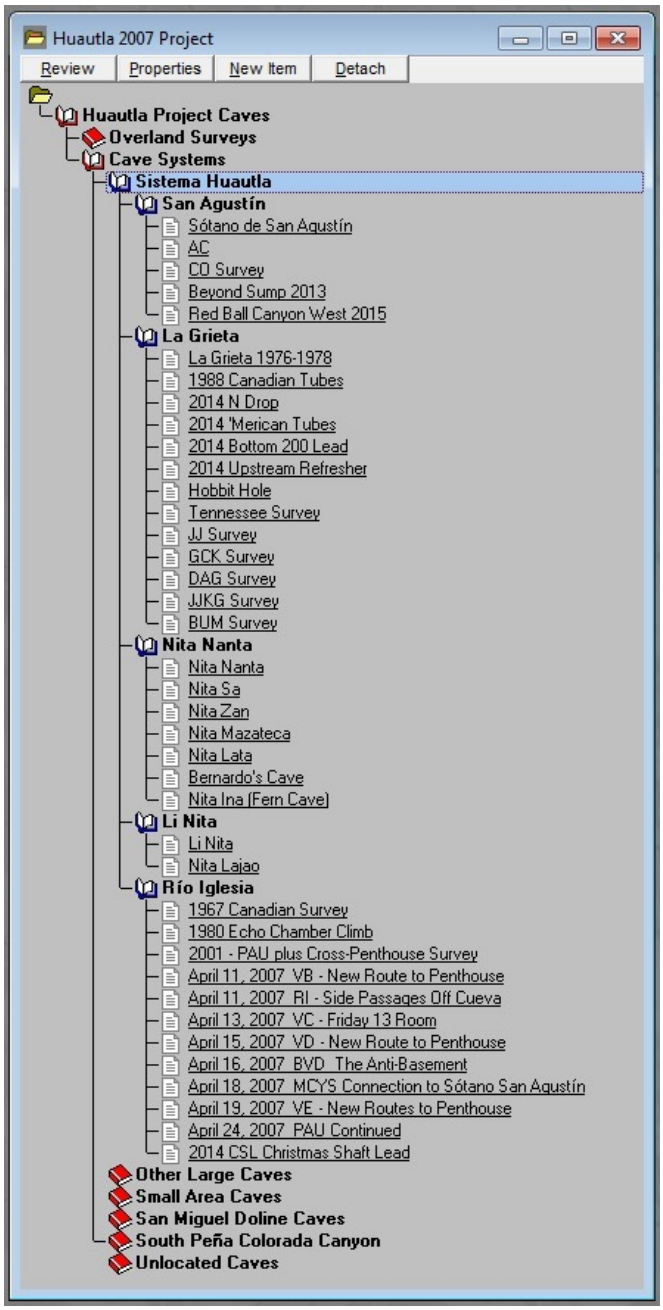
The Sistema Huautla exploration and survey effort is celebrating its 50th anniversary in 2015, and the 2nd of ten annual expeditions planned from 2014 through 2023 has just concluded. There have been several cartographers and cartographic tools/techniques used over the history of the project, but relatively little recent activity. There is a broad consensus that there is a need to bring old maps into the digital age and keep the maps updated as new survey is added. These maps can be used as a framework for various scientific or cultural studies, communication of new discoveries to the caving community and general public, for improving the productivity and efficiency of future exploration, and for help with expedition planning. There is also a consensus that standards should be established for the cartography with respect to map scale and orientation, symbology, fonts and line weights, digital storage format, etc. such that maps of different sections of the cave can be more easily integrated, and so that the work of the project is representative of the collaboration and cooperation of its members. This guide gives an overview of the standards that should be followed by cartographers. It is understood that the level of detail may depend on the limitations of scale, and the quality of the original sketch notes. It is also understood that each cartographer's style and sense of aesthetics varies and each map will reflect that individuality.

Survey Data Management

Walls survey software, authored by David McKenzie, is being used for data entry, compiling raw data into useable 3D cartesian coordinates, closure of loops and error distribution, export of line plots for incorporation into scalable vector graphics (SVG) drafting programs such as Adobe Illustrator, and morphing of digital maps to fit updates to the data using a process called roundtripping. As of this writing the current version is Walls v2 B8, but it is expected that new versions will be issued and that they will be backwards compatible with older data files. An updated data file is being made available to all cartographers via the shared cloud drive (currently Dropbox) and all cartographers should be using this software with the latest data to ensure alignment between various sections of the cave system. Other cave survey software, such as Compass by Larry Fish, uses different algorithms for distributing loop closure errors, which affects the exact location of stations following compilation and closure. There is not a consensus regarding the best strategy for distributing closure error, but for the sake of consistency the project has elected to standardize by using Walls. Individual surveyors or cartographers may make changes to the online copy of the data file, but please clearly communicate any changes to all cartographers and the project data manager (currently Tommy Shifflett). Tommy will be responsible for maintaining the master data file. The data file is organized in a tree-like structure, which contains data on Sistema Huautla (San Agustín, Nita Nanta, Li Nita, La Grieta, and Rio Iglesia), as well as a large number of large and small separate caves that are all linked together by an overland survey connecting their entrances. Figure 1 shows some of the layers in the current file.

Figure 1. Huautla area Walls project tree





Map Layout and Scale

The caves of Sistema Huautla drain from north to south and therefore have more of their passages oriented in this general direction. Historically most maps of the region have been oriented so that true north is to the left of the page and east is to the top of the page. This allows the map aspect ratio to be in landscape, and this provides better use of the page when including projected profile views along with the plan view; however, profile views can easily be drawn as a separate map sheet, or placed anywhere on the page with whatever projection angle, or combination of angles to take advantage of the space that is available. While there may not be a consensus, it is proposed that future maps be oriented with north at the top of the page to avoid confusion. Most newcomers to the project and the general public are often confused and disoriented when viewing maps where north is oriented in a direction other than the top of the page. Another important consideration is the scale to use for drafting. When viewing the map digitally (such as a computer monitor or tablet) the drafting scale is of little importance, but there is often a desire to produce printed copies of the map for wall display or in publications such as the AMCS Bulletin. Large format printers are available to members of the project with the largest commonly available size having a width of 42 inches. Roll media allows for lengths up to 150 feet (i.e. no practical limit). To simplify the process of scaling survey notes, printing maps, or generating GIS overlays, it's generally better to use scales that are round numbers. Taking this into account, and matching the dimensions of each cave section to the maximum practical print medium, a scale of 1:2,000 is recommended. The largest section is San Agustin, which at this scale will fit on a page that is 42 inches wide by 60 inches tall. Recommended orientations and page sizes for each section are shown in Figure 2.

Map Elements

There are a number of basic elements that should be included on every map including: title, geographic location, equipment used and survey grade, scale bar, north arrow, and a legend. It is suggested that each map use the same font type, font size, scale bar, and north arrow. The legend needs to explain the symbols, brushes and patterns used on the map to represent the features of the cave. Plan, profile, and cross-sectional views may contain different elements, and each cave may have unique mineralogical or cultural features, so the legends can be adapted to fit the needs of a given map. A border can be used as well to help define the boundary of the map. Below are the elements that are used in the existing map template:

Font - Avenir
Title for the cave system (Sistema Huautla) - Avenir Medium, 84 pt
Subtitle for cave name (e.g. Sótano de San Agustín) - Avenir Roman, 60 pt
Geographic location - Avenir Light, 48 pt
Survey information - Avenir Light, 24 pt
Border - single box, 4 pt, black, 0.5 inches from edge of page

An example title block is found in Figure 3. An example north arrow and scale bar is found in Figure 4.

Figure 2. Recommended page size and orientation at 1:2,000 scale (plan views)

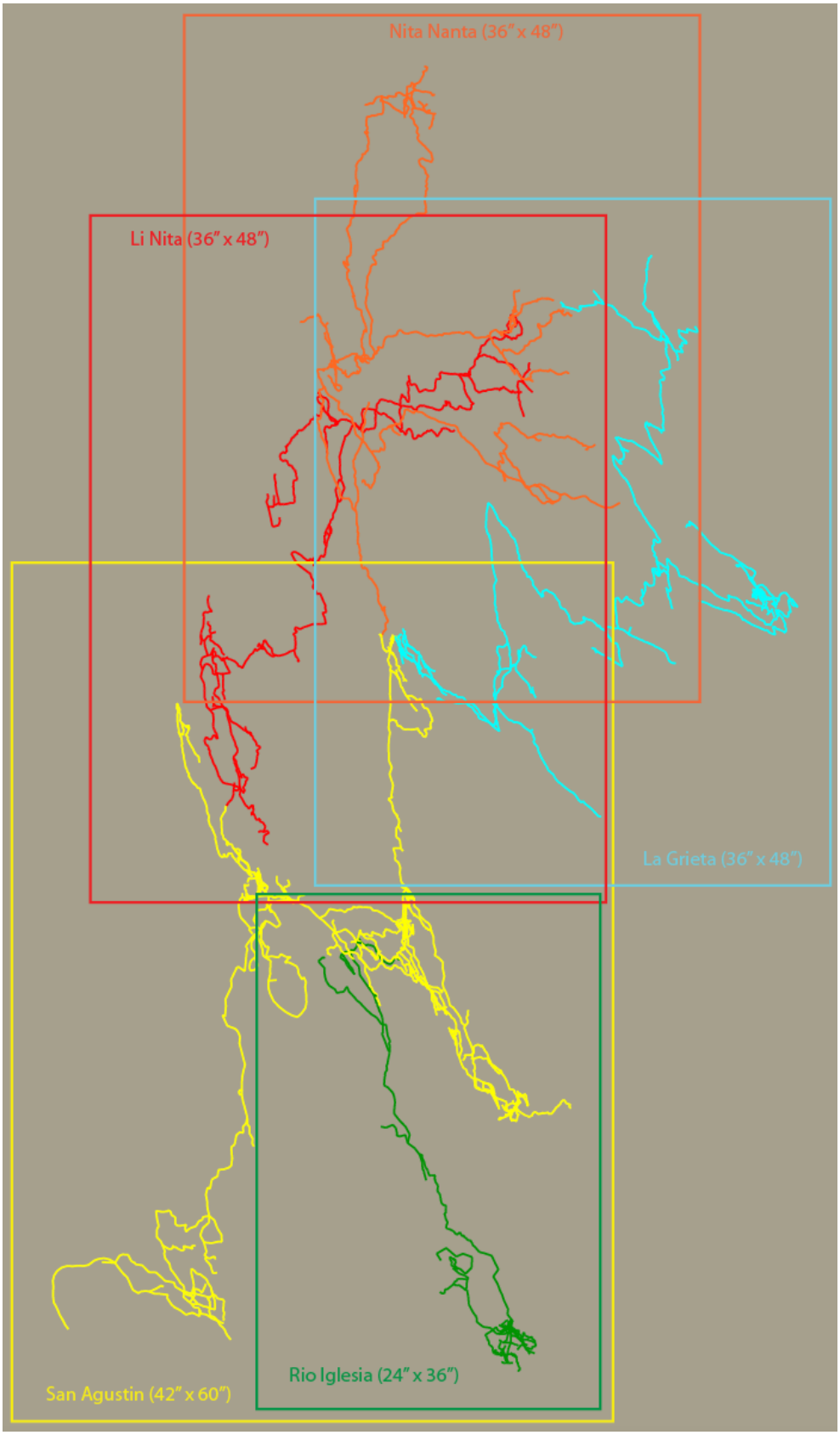


Figure 3. Example title block

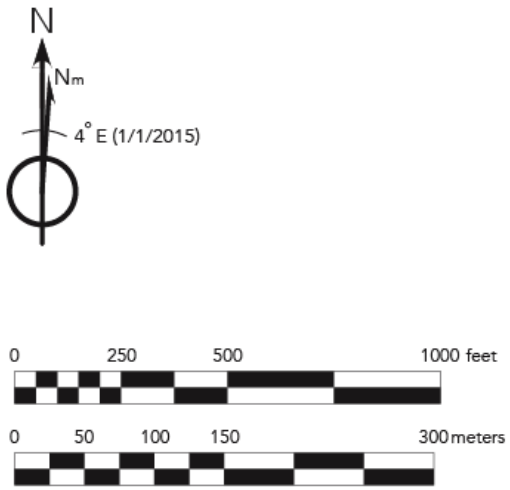
SISTEMA HUAUTLA

Sótano de San Agustín

San Agustín Zaragoza, Municipio de Huautla de Jimenez Oaxaca, México

Total surveyed length of Sistema Huautla: 71,412 meters
Surveyed length of Sótano de San Agustín (shown on map): 23,622 meters
Total surveyed depth of Sistema Huautla: 1,554 meters
Surveyed depth of Sótano de San Agustín (shown on map): 1,060 meters
All elevations and heights in meters
Data reduction and plotting: Walls v2 B8 by David McKenzie
Drafting: Adobe Illustrator CS6
Surveyed from December, 1966 to April, 2015
Compass, inclinometer, tape, and Disto-X survey by:
Proyecto Espeleológico Sistema Huautla (PESH)
United States Deep Caving Team (USDCT)
Association for Mexican Cave Studies (AMCS)

Figure 4. Example north arrow and scale bar



North

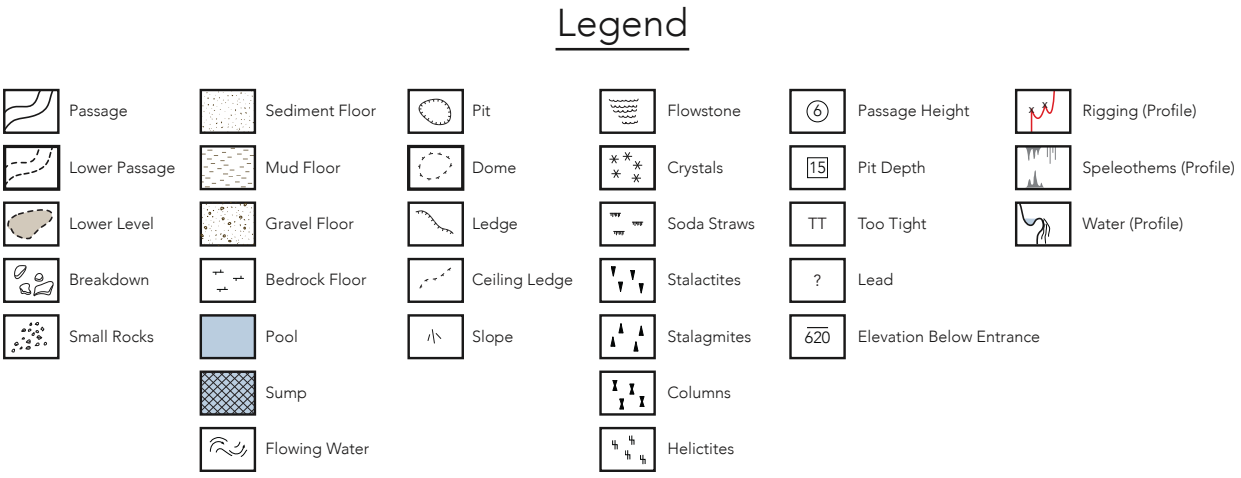
It seems like a simple concept, but the reality is there are many different norths that are similar but not precisely the same. True north is the direction to the Geographic North Pole. It is a fixed direction and is the standard reference used by most maps. Whenever a map simply has

an arrow with "N" it is presumed that this represents true north, so a "t" or "true" subscript is not necessary. Grid north is the northing direction of local grid coordinate system (usually UTM). UTM coordinates are based on a series of rectangular zones superimposed on the surface of the Earth, which is spherical. Within a small area the spherical curvature is relatively small and the grid system is easier and more intuitive for navigation. As a result, there may be a small deviation between grid north and true north that can vary depending on the exact location within the grid. In most cases the deviation is small (less than a degree), and is often ignored. Magnetic north is the direction indicated by a compass, which varies from true north by an angle known as the declination. The Magnetic North Pole is constantly changing, so the declination is also always changing, and the angle depends a lot on your reference location. The Magnetic North Pole is approximately 4 degrees east of the Geographic North Pole in region of Sistema Huautla in 2015. Survey measurements are, in most cases, relative to magnetic north and have to be adjusted for declination when generating a finished map. It's fine to sketch a cave with magnetic north as a reference, but finished maps should never be drafted with a magnetic north reference because they will become inaccurate as the declination changes. It is acceptable to put a magnetic north subordinate reference arrow on a map as a navigational aid if the date referencing the declination is also included and they are labeled with "N_m", "N_{mag}", or the like. By convention, true north arrows should always be double-sided, whereas magnetic north arrows should be single-sided.

Drafting Standards

Standard brush strokes and symbols have been developed for use in drafting cave maps. Several organizations have standard symbols and these may vary slightly from region to region. Cartographers in the Sistema Huautla region, including Bill Stone and Jim Smith, have used a set of symbols that is common to most AMCS maps. Those should continue to be used; however, there are artistic variations on the exact form of these symbols and brushes. For efficiency and consistency, a set of symbols, brushes, and swatches have been developed for the generation of modern digital maps. These are shown in the example legend in Figure 5.

Figure 5. Example legend showing standard AMCS symbology



In addition to the use of established symbols, standardization around line weights and styles will help maps look consistent. The use of heavier weight lines for walls and pillars relative to ledges, rocks, floor detail, etc, helps the cave passage to be more easily distinguished from detail within the walls. Excessive use of color can be distracting and make it more difficult to read a map, but limited use of color to depict overlying passages that may be drawn as a horizontal or vertical offset, or to identify water features can enhance a map. The following are recommended drawing standards:

Passage walls - 1 pt stroke weight, rounded corners and ends
Lower levels- 1 pt stroke weight, 3 pt dash / 2 pt gap, rounded corners and ends
Floor and ceiling ledge brushes - 0.5 pt stroke weight (use brush library)
Boulder and rock outlines - 0.5 pt stroke weight (free draw with pencil tool)
Boulder detail - 0.25 pt stroke weight (free draw with pencil tool)
Slope - 0.4 pt stroke weight (draw with line tool rather than using a symbol)
Flowstone - 0.5 pt stroke weight (free draw with pencil tool)
Floor detail (sediment, mud, gravel) - draw outline with pencil and use swatch library
Floor detail (bedrock) - use symbol library
Speleothems - use symbol library
Leader lines (annotation, offsets, ceiling heights) - 0.5 pt stroke weight (line tool)

Include the PESH logo to honor the organizers and sponsors of the expeditions that make all of this possible.

Layers

The use of layers in digital drafting software significantly helps with organization and customization of maps. If the cartographer wishes to use roundtripping (not discussed in detail here) as a way to keep the drafted map aligned with the latest line plot, then drawing elements need to be put into specific layers with a standard nomenclature so that morphing is applied appropriately. For example, title blocks and legends don't get morphed at all; cross sections, ceiling heights, formation or bedrock symbols, and text descriptions get moved relative to moves in the line plot, but not stretched or skewed; and walls, ledges, and water

features need to get morphed to fit changes in length and orientation of the reference survey data. Layers can be turned on or off to display more or less detail as desired (e.g. showing the line plot and station labels in working maps, but hiding them for a publication). Figure 6 is just an example from the San Agustín map.

Figure 6. Adobe Illustrator layers for the San Agustín map