High Accuracy Reference Network (HARN) Update

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It was just a few short years ago that surveyors were the only ones actively involved in the business of **positioning.**[1] But times change, as does technology. Today it seems as if everybody is involved in some sort of positioning. And much of that positioning is performed using a group of artificial earth satellites known as the Global Positioning System, or GPS.

Some of those positioning activities currently involving GPS are: private transportation where the locations of fleets of delivery vehicles are monitored on a continuous basis; public transportation where onboard computers reroute travelers around heavy congestion; law enforcement where accident scenes are surveyed; agriculture where precision farming is practiced; and environmental management where hazardous spills must be located quickly and accurately.

New applications of GPS positioning are coming on line everyday. A couple of good example involve the use of cellular telephones in automobiles. It may well be that both routine 911 callers and accident victims in vehicles equipped with air bags may be located via satellite. The list goes on and on.

There is one problem common to all such applications of GPS however. And that is that both today's uses and today's technology far outstrip the capabilities of today's **geodetic infrastructure**. That infrastructure must be updated to meet current needs and capabilities.

The Indiana High Accuracy Reference Network is the solution to that problem. It will be modern, capable of meeting today's needs, and designed specifically for today's users. The Indiana **HARN** will be a subset of existing **markers**, with some new markers thrown in here and there, spread out around the state that can be used to support the modern **positioning** or **locating** of people, places, or things at or near the surface of the earth.

These HARN markers will differ from current points in a very important way. HARN markers will all provide clear views of the sky for GPS surveys. HARN markers will all be accessible to motorists for quick and easy access. And most importantly, HARN markers will all have consistently high accuracy, in line with expectations of today's GPS users. This high accuracy will be achieved by performing a high precision GPS survey.

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[1] Those terms which have been highlighted are defined in the attached glossary.

HARN points will be known to the nearest inch whereas existing points are only known to the nearest foot.

The preliminary estimate for updating (or establishing) each marker is $3,000.00. This assumes all work will be performed by **NGS**. Any and all help provided to NGS prior to and during the campaign will help lower marker costs.

Since these HARN points can and will be used to locate section corners, money from the corner perpetuation fund can be used to establish a HARN point. Payment can be made in a lump sum or in installments in the event insufficient funds are available at this time.

It is our hope that Indiana develops a 92 point HARN, that is one HARN point per county. This will allow users to be within at least 35 km of the nearest HARN point and thus be able to survey using the less expensive survey grade GPS receivers. To this end we have asked all Indiana counties, through their county surveyor, to sponsor a HARN point.

As of March 18th, 61 new HARN points have been pledged by 36 county surveyors on behalf of their respective counties (see attached list). Add in the roughly 20 HARN points to be provided by NGS and it looks like we are on our way towards the 92 point HARN we had hoped for. However, the layout will be less than ideal. Assuming NGS locates their HARN points in 20 of the remaining 56 counties, 40% of Indiana counties will still be without a HARN point.

If you will recall, in the beginning of this century our ancestors had the foresight to sponsor a reference network the benefits of which we have enjoyed for two to three generations. You are now in a position to make a similar decision concerning implementations of a modern geodetic reference network. Not only current, but future generations of, surveyors, engineers, planners, law enforcement officials, motorists, etc. will reap the fruits of your decision to sponsor the Indiana HARN. Please consider sponsoring a HARN point in your county. If you have questions you can call us at 1-800-428-7639 or speak to one of your fellow commissioners who have already committed to sponsoring a HARN point.

GLOSSARY

Geodetic infrastructure - Geodetic infrastructure is the set of **markers** typically used by surveyors to help them find out exactly where they are. These markers enable surveyors to establish a bearing and a sort of beginning point for their surveys. They are typically little brass caps set in concrete, buried flush with the ground. You've probably seen them while walking around the neighborhood. They can be found in the city, out in the country, and anywhere in between.

There are actually two different kinds of markers even though they both look the same: bench marks and horizontal control stations. Bench marks are used to determine heights in the one dimensional vertical plane. Horizontal control stations are used to establish positions such as north and east, latitude and longitude, or X and Y in the two dimensional horizontal plane.

These markers have some useful characteristics. For one thing, the position of any of these markers is fairly well known with respect to all other such markers located around the world, no mean feat. This means that if someone built a railroad east from San Francisco, relating it to local geodetic markers, and then someone else built a second railroad west from Saint Louis, also relating it to local geodetic markers, both parties could plan on meeting somewhere in-between. That is just what the railroads did in the late 1800's when they met in Promontory, Utah.

HARN - The High Accuracy Reference Network will be a subset of the existing markers found in and around Indiana. What will make these markers special is that the relationships between each and everyone of them, their relative positions in survey speak, will be very well known. When these relative positions are well known, the points are said to be precise. When the relationships between these markers and the actual center of the earth are also well known, then the markers are said to be accurate. HARN markers will be both more precise and more accurate than regular markers.

The accuracy of HARN markers will range from one part in one million (a millimeter in a kilometer or an inch in 15.8 miles - now you see why we are all headed toward metrics!) to one part in ten million (a millimeter in ten kilometers or a inch in 157.8 miles)! A far cry from one part in 10,000 (the lower end for regular markers) to one part in 100,000 (the high end for regular markers).

HARN markers and regular survey markers have no physical differences however. They are both brass caps set in concrete, buried flush with the ground. What differs physically may be where they can be found. HARN markers will never be located beneath trees because you need a clear view of the sky to use GPS. Regular survey markers, on the other hand, may be found beneath trees, next to old barns or large buildings. To use a regular survey marker, with regular

surveying tools, all one needed was a clear view of the next hill. And a shade tree to block out the glare of the sun was not necessarily a bad thing.

Think of these survey markers in terms of computers. Regular survey markers were both precise and accurate in 1981, relatively speaking, prior to the widespread use of GPS. And IBM PC's were fast in 1981. But in 1995, neither cuts it any longer. GPS is ten times more accurate and today's Pentiums are, well, they don't even compare. Times change, as does technology. And with that, so change our yardsticks. Original PC's are used as doorstops today and what about regular survey markers? If not updated soon, they may go the way of the original PC.

Locating - The art of expressing positions in conversational language such as "the corner of First and Main Streets". The location of the point 273° 05′ 07″ East and 40° 25′ 50″ North, a two dimensional position, is the center of the Civil Engineering Building at Purdue. In three dimensions, the point 273° 05′ 07″ East, 40° 25′ 50″ North, and 184.5 meters above the reference ellipsoid is located on the roof of the penthouse of the Civil Engineering Building.

NGS - The National Geodetic Survey, the branch of the federal government responsible for surveying.

Positioning - The science of determining where someone or something is expressed in an arcane language only computers were meant to understand, such as degrees, minutes, and seconds. For example, a position 273° 05′ 07″ East and 40° 25′ 50″ North refers to someone or something 273° 05′ 07″ East of Greenwich, England and 40° 25′ 50″ North of the equator . This position expresses where someone or something is in two dimensions (East and North). Should one be interested in a three dimensional position, a height above a reference surface would be included. Using the same example, we have a position 273° 05′ 07″ East, 40° 25′ 50″ North, and 184.5 meters above the reference ellipsoid. Positioning is different from the term **locating,** described above.

Markers - Also referred to as points or stations. Multiple terms used in attempt to confuse the uninitiated. Markers, points, stations, or whatever, they are still those little brass caps referred to under geodetic infrastructure and found on Aunt Martha's back forty.