

OIL & GAS INDUSTRY SOLUTIONS

**ACQUIRE
ANALYZE
ANSWER**



Pipeline
Integrity

We deliver precise geospatial insights that support a variety of decision makers with services including: Exploration, Siting, Environmental Monitoring, Geologic Hazards, HCA Identification and Class Location, and ROW Encroachment Detection.

Why NV5 Geospatial?

NV5 Geospatial (NV5G) is a full-service geospatial firm specializing in data generation, integration, and analysis for oil & gas clients worldwide. We bring over eight decades of collective experience in conducting aerial surveys and providing geospatial point and pixel data. We provide comprehensive aerial mapping and GIS services including state-of-the-art imagery, point clouds, hyperspectral, thermal, and video airborne imaging, and mapping. Our client base includes a host of midstream oil & gas utilities as well as many of the top engineering and industrial firms in North America and beyond.

NV5 Geospatial's core offerings for the oil & gas industry are based upon a solid foundation of quality data. High resolution point clouds and orthoimagery delivered at or above client specifications populate land base information for our clients. In the last 2 years alone, NV5G has collected orthoimagery and point cloud information for well over 40,000 pipeline corridor miles. Building upon the high volume of precise land base data, NV5G is also able to provide many valuable analytic products that enhance the safe and reliable operation of oil & gas pipelines. Our analytic solutions include: Structure Classification, Vegetation Characterization, Encroachment Analysis, Terrain Hazard Analysis, Corridor Change Detection, Emergency Response Data Capture, Greenfield Survey, Above-ground Pipeline Integrity Analysis, Asset Road Access, and Environmental Evaluations.

ACQUIRE



**AIRBORNE LIDAR
TOPOBATHYMETRIC LIDAR
GROUND MOBILE LIDAR
LARGE FORMAT CAMERAS
OBLIQUE CAMERAS
THERMAL INFRARED IMAGING
HYPERSPECTRAL IMAGING**



Bulk Data Delivery

NV5 Geospatial has established a reputation for the collection of massive datasets that encompass entire regions of North America. We collect this data with an acute awareness of timelines, data accuracy, and client expectations. Quality data collection and delivery is the foundation upon which analytic insight and geospatial understanding is built. The data may be delivered in a variety of forms other than the native data format such as ESRI surface files, ASCII text files, ECWs, MrSID, etc. This data is typically shipped via hard drive in the mail to clients who will then use the data for further analysis. flights across a variety of asset classes and environmental conditions.

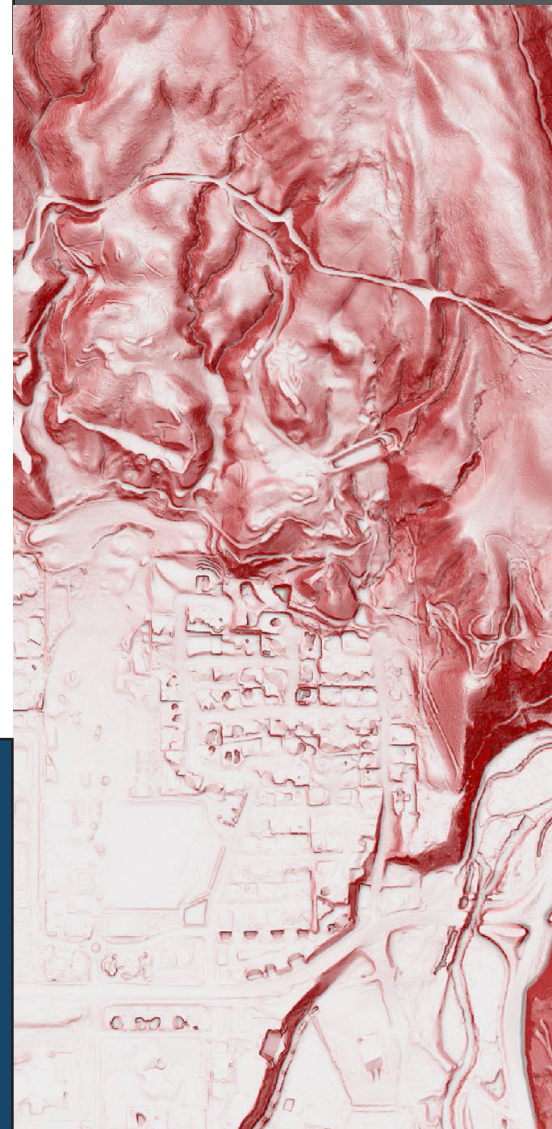
Greenfield Survey

Greenfield survey is the capture of baseline data for the planning and construction of utility assets where none exist currently. In most cases this is differentiated from "Bulk Data Delivery" by virtue of the fact that derived data is created from baseline data and some analytics are produced in support of the design and construction of assets. Some derived and analytic elements can include: Identification of water or wetlands, locating overhead crossing wires, quantification of vegetation, slope characteristics, or placeholder asset siting.

Planimetric Maps

Planimetric features consist of both man-made and natural features. 2D or 3D vectors can be created for structural or surface features from orthoimagery, stereo compiled orthoimagery or lidar point clouds. Planimetric features are represented as lines, closed polygons, and points. When extreme accuracy and detail are required, utilizing the lidar point cloud allows for greater precision than traditional stereoscopic planimetric techniques since ground-level features are not obscured by overhead vegetation. Several custom tools developed in-house convert specified classes of lidar points to the planimetric shapes. NV5G can provide a continuous planimetric map and will meet the absolute accuracy requirements of the remotely-sensed data. The image depicts vectors derived from 20ppsm lidar that may impact engineering design or analysis and are commonly provided by NV5G vegetation, building, water, railroad, paved road, dirt road, fence, wall, pipe, gutter, concrete pad, etc.. Any number of attributes can be assigned to planimetrics to increase value such as, tree or building height, crown or building area, and other customized attributes.

- Engineering grade accuracy of spatial rectification, attention to detail
- Quick and efficient processing taking a fraction of the time it takes to conduct a traditional walking survey
- Client-owned data can be leveraged to local entities with jurisdictions coincident with data coverage
- Custom modeling and reporting tailored to the exact specifications of each client
- Ability to track changes over time and show improvement and environmental stewardship of Right-of-Way management



ANALYZE

SPATIAL RECTIFICATION
3D ASSET MODEL
ASSET INVENTORY
ENGINEERING DESIGN
TOPOGRAPHIC MAPS
PLANIMETRIC MAPS
ORTHOPHOTOS

FULL FEATURE CLASSIFICATION
3D AND 4D MODELS
VEGETATION ENCROACHMENT
VEGETATION SPECIES AND HEALTH
BULK DATA DELIVERY
CHANGE DETECTION
GREENFIELD SURVEY



Pipeline Integrity Analysis

Encroachment Analysis

From crossing wires to, unauthorized tool sheds, to trailers; NV5 Geospatial can identify encroachments in the built environment. NV5G will identify and classify built structures and other human-caused physical encroachments that may limit a utility's access or safe operation of their pipelines.

Vegetation Management

Vegetation analytics for a pipeline ROW identify areas of potential subterranean root interference and provide a quantified understanding of trees that may potentially impact the pipeline system. NV5 Geospatial can locate tree tops, tree crowns, and even tree trunks for precise root ball location and offset identification. All this information can be combined with species identification to understand specific vegetation risk. It is understood that specific tree species in certain geographic regions are responsible for a majority of vegetation-related disruptions. In some cases, vegetation can be classified as an asset for carbon sequestration or "Integrated Vegetation Management for pipelines."

Terrain Hazard Identification

Lidar modeling reveals subtle surface features that are undetectable via aerial photographs or field observation, leading to unparalleled richness in resulting topographic models. After semi-automated terrain hazard identification, all areas are subject to rigorous quality control by staff geologists. Areas of landslide risk are reported and combined with asset information to prioritize mitigation efforts.

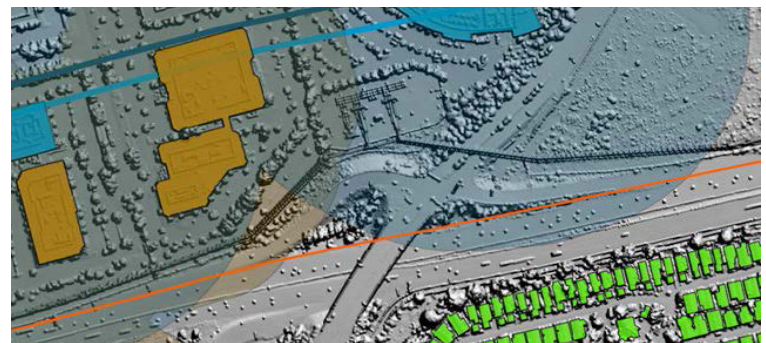
Above Ground Pipeline Integrity Analysis

System-wide measurement of elevations along the top of your pipelines can identify pipes that are deflecting beyond established tolerances with high accuracy. Annual surveys reveal movement and can help to plan and prioritize mitigation efforts. Mapping of above ground oil pipelines and integrity analysis can identify pipeline supports that are sinking or jacking due to freeze/thaw cycles or terrain movements. NV5 Geospatial collects high density airborne lidar and compares horizontal support members (HSMs) to client provided database of pipelines. To analyze HSM tilt, vectors are created in Bentley MicroStation for every HSM identified in the lidar point cloud data, then the angle of tilt of these lines is calculated. Analysis is conducted to identify structures that are in danger of causing pipeline failure due to frost heave or permafrost thaw resulting in sinking, uplift or tipping of support structures.

HCA and Class Coding Analysis

Understanding exactly what is near pipeline infrastructure is crucial for effective and safe operation. High Consequence Area (HCA) and Code Classing analysis determines pipeline safety risk and ensures regulatory compliance from a structural perspective. NV5 Geospatial creates HCA vectors based on the U.S. Department of Transportation's guidelines. In collaboration with our clients, NV5G assesses the distance from a potential explosion at which death, injury or significant property damage could result. This distance is known as the Potential Impact Radius (PIR), depicting potential impact circles. PIR areas will be tested and evaluated at all points along the pipeline corridor and then delivered as vector boundaries. All PIR areas are attributed with the population they contain. NV5G is also familiar with Code of Federal Regulations (CFR) Title 49, Part 192, that details code classification of natural gas pipelines. By determining residential unit counts as well as Class 3ii and Class 4 qualifying structures, NV5G can effectively identify the safety risk to a population of any given section of pipeline.

High Consequence Area Analysis



Access Roads

NV5 Geospatial can provide comprehensive mapping and attribution of remote utility access roads that are not captured in existing map services (google, etc). We identify access roads, their construction material, and condition to create an asset navigation database for "last-mile" routing, maintenance planning, calculating response times, and providing alternate route navigation. Last-mile access roads can be utilized for off-line navigation to assets.

Change Quantification

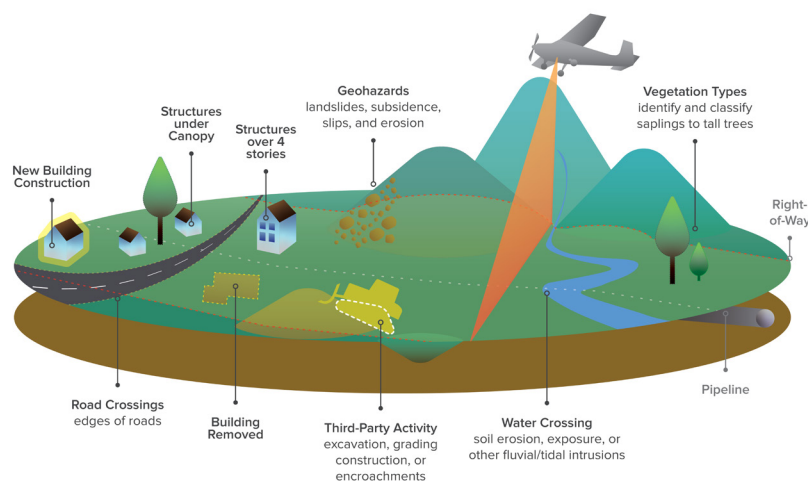
Change detection can isolate any identifiable features captured by remotely sensed data year-over-year. Maintenance effectiveness can be evaluated each year if desired. The high degree of absolute accuracy of our data (~5-10cm) allows for detailed change detection. NV5 Geospatial couples this precise change detection analysis of the lidar point cloud with proprietary tracking methods for detailed comparisons of individual assets and features year after year.

Emergency Response

System-wide data provides a snapshot in time of a pipeline network. The ability to verify and quantify the exact state of infrastructure, before and after an emergency event, is the first step to restoring critical assets. Comparisons of asset inventories, encroachment evaluations, and the spatial arrangement of a pipeline network, can quickly determine actionable next steps informed by data. NV5G provides emergency response services in the event of any type of emergency from fires to hurricanes, earthquakes, flooding, and everything in between.

ANSWER

REGULATORY COMPLIANCE
LAND USE AND PERMITTING
INFRASTRUCTURE MANAGEMENT
DISASTER PREPAREDNESS
HCA AND CLASS CODING ANALYSIS
ENCROACHMENT ANALYSIS
TERRAIN HAZARD IDENTIFICATION
ABOVE GROUND PIPELINE INTEGRITY ANALYSIS
ACCESS ROADS
ENVIRONMENTAL HAZARD ANALYSIS



NV5 Geospatial INSITE Platform

To make the vast amounts of collected geospatial data and analysis most valuable to the oil & gas industry, NV5 Geospatial is proud to offer its INSITE software platform. NV5 Geospatial INSITE provides a simple map and dashboard interface that allows interaction with analysis results as well as complete work order management that effectively turns your geospatial data into action. NV5G's core mission is dedicated to advancing the achievements of our client-partners through the acquisition of datasets, development of support applications, and delivery of related services that enable our clients to more efficiently conduct their operational missions. We Acquire, Analyze, and Answer and provide business intelligence in the NV5 Geospatial platform.

