

# HAZARDOUS SLOPES

## *Surerus Murphy has Technical Knowledge in Engineering and Construction in Mountainous Regions*

*Building pipelines through Canada's mountainous terrain and rugged foothills requires specialized knowledge. Surerus Murphy Joint Venture has optimized our experience in steep slope construction, allowing us to pass on safety and efficiencies to our clients.*

### **TECHNICAL OVERVIEW:**

Western Canada's beautiful, mountainous landscape is full of steep slopes. Building pipelines along this terrain requires skill and knowledge to safely employ equipment and pipe along difficult angles, and often in rural locations and in inclement weather.

Surerus Murphy has specialized equipment, internationally experienced engineers and uses the latest technology to offer safe, efficient, and high-quality steep slope construction to pipeline owners.

### **EQUIPMENT ADVANTAGE:**

- Equipment is upgraded, tested, and regularly inspected for hazardous slope applications.
- Equipment has custom-engineered anchor points for winching equipment up/down mountainous terrain.
- Engineering team has selected and trialed mobile winches and deflection rollers to safely and efficiently construct right-of-ways (ROW) and install pipe on hazardous slopes.

### **TECHNOLOGY, PROCEDURES & DESIGN ADVANTAGE:**

- Real-time data captured from drones-based photogrammetry and Light Detection and Ranging (LiDAR) methods, along with publicly available sources is used for real-time decision making, reducing the requirement for employees to physically be on dangerous terrain.
- Bespoke plans for winching operations are developed for each hazardous slope and they are based on engineered calculations, field data, and equipment specifications.
- Engineering and operational teams perform side boom stability testing, acquiring data to support hazardous slope calculations and work plans. This provides verifiable data validating design and safety factors used on hazardous slopes.

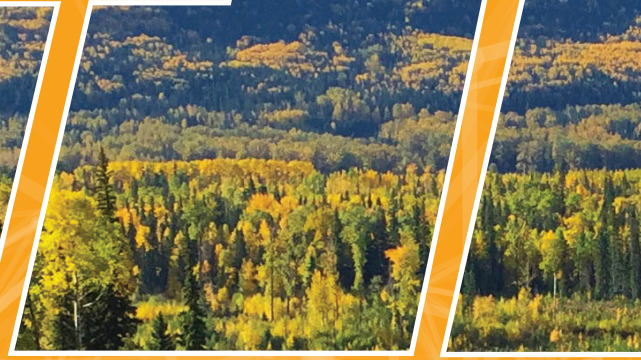
### **ENGINEERING & SURVEYING ADVANTAGE:**

- Many members of Surerus Murphy's engineering and technical teams hold Transport Canada - recognized Advanced Drone Pilot certification to operate an unmanned aerial vehicle (UAV), used to gather field data.
- Survey data collected via UAV-mounted LiDAR and photogrammetry and publicly available GIS information is used to produce detailed grade design packages.
- Machine-controlled GPS is installed on equipment ensures optimal grade and ditch design is followed in the field.
- In-house engineering and survey for all elements of slope construction design, including 3D modelling, and virtual reality. Survey data is collected by UAV, mounted LiDAR and photogrammetry, GPS and other methods.
- UAVs are piloted by in-house certified drone pilots.
- Temporary work design, including winch sizing, equipment upgrades, anchor designs and lifting capacity calculations are derived from ISO 8813 field testing.



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