Designing a Haulage Network with a Gridded Seam Model

MineSight® Haulage (MSHaulage) was introduced in mid 2008. MSHaulage can be used with block model designs and gridded seam models (GSMs). In this article we will explore the design of a haulage network for a GSM project.

The gridded seam model is most commonly used with flat lying deposits and metal vein deposits. For this article we will use a flat lying coal project that employs a simple side casting mining method.

A GSM follows the elevations of the modeled seam instead of using fixed benches like that of a 3D Block Model (3DBM). The pit is designed to the base of the seam (Figure 1). The coal seam is strip mined and the cuts are made along the strip. MSHaulage will be used to create a road network from the active mining area at the coal seam to the dump, plant and other workings on the pit exterior.

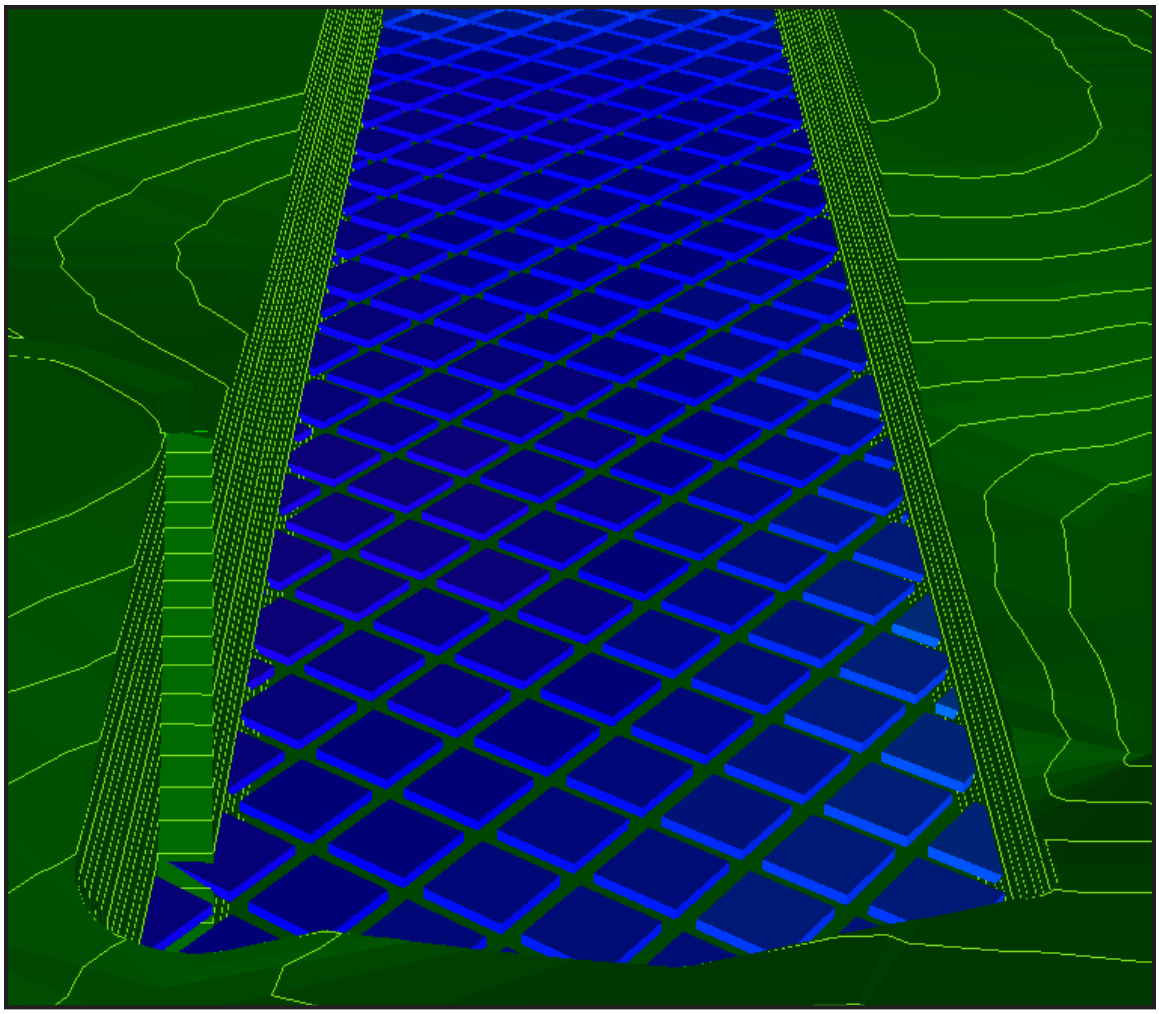

Figure 1. Strip pit designed to the bottom of the coal seam which is modeled with a GSM.

Preparing to Use MSHaulage

MSHaulage is accessed via MineSight® 3-D (MS3D). There are a few tasks that need to be performed in order to prepare for the use of MSHaulage:

1. Database preparation
   a) First an SQL database needs to be created. MineSight® utilizes SQL 2005 or greater. To create the database use the **Database Manager** tool located in the **MS3D Utilities| Database | Database Management** menu. From here, create a MineSight® Planning Database (MSPD), formerly known as an Attributed Geometry Data Model (AGDM).
   b) Establish a database connection using the **Connect To Attributed Database** function under the same menu.
2. Haulage network digitization and design.
   a) Points need to be digitized into a geometry object within the haul road network at sources (e.g., strip pit bottom), destinations (e.g., coal processing plant), stockpiles, and tie-nodes (e.g., road intersections), see figure 2.

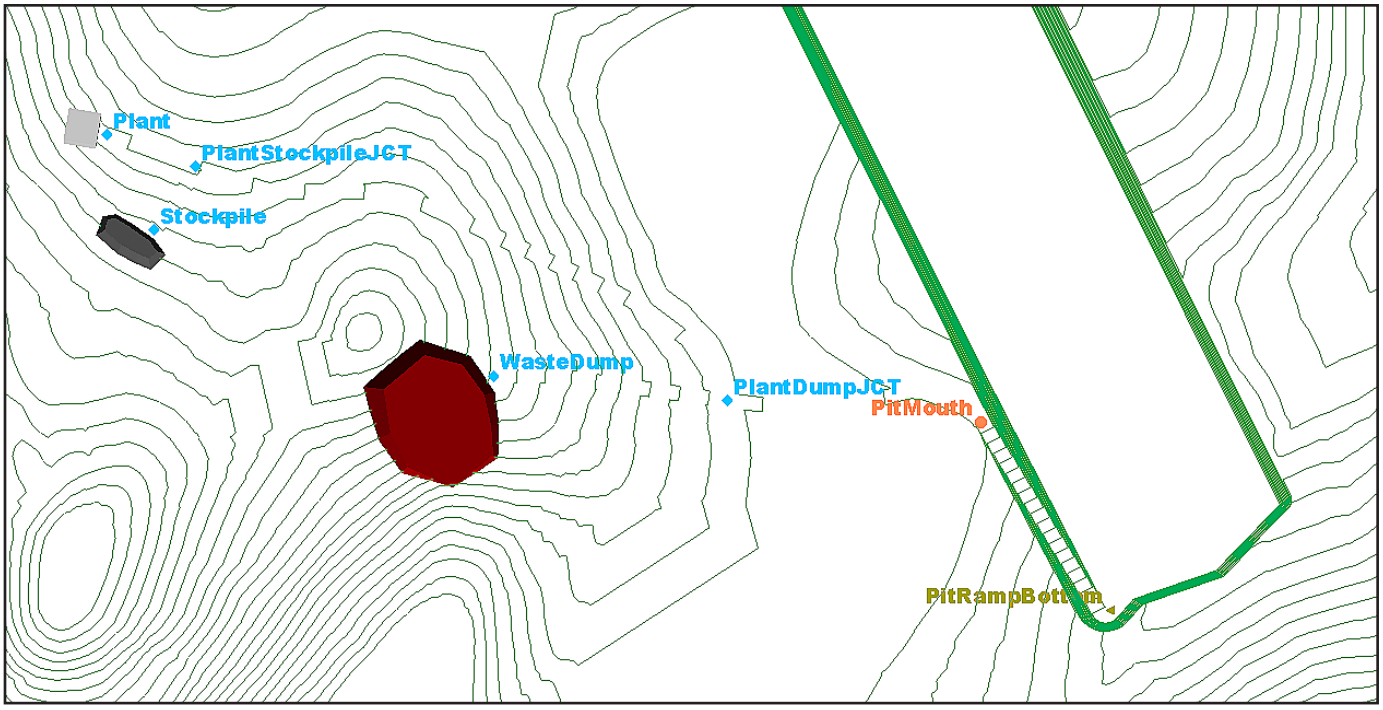

Figure 2. Attributed road network points.

b) Within the MS3D, project digitize polylines along the haul roads. Each road section must be between two of the points digitized in the previous step. To achieve this, point snap can be used to snap the polyline end points to the attributed points. These road polylines can optionally be attributed using the **Element | Attribute** function (Figure 3).

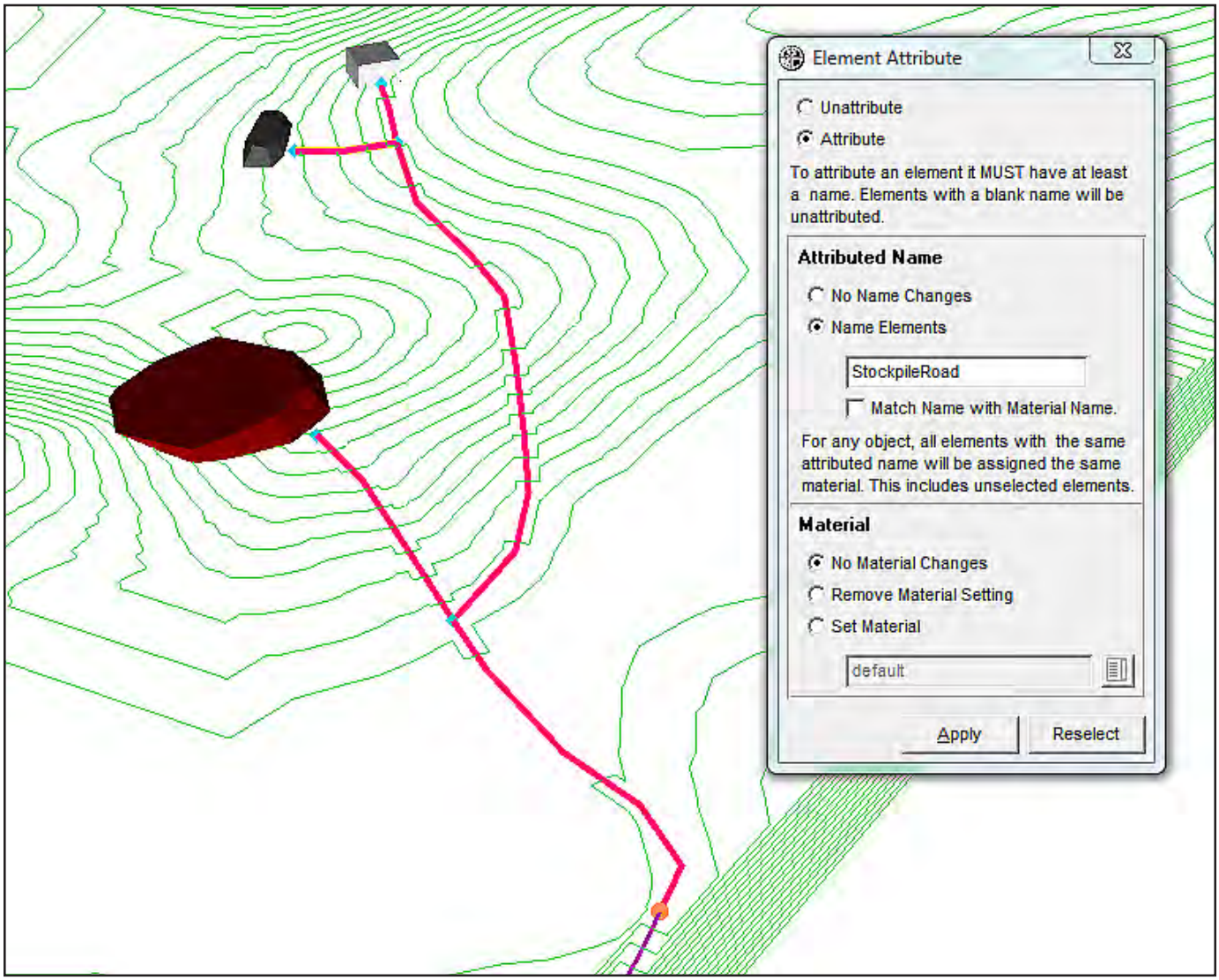

Figure 3. Attributing the Stockpile haul road with an element name.

MSHaulage is now ready to run. MSHaulage is accessed through the **Engineering Tools** menu in MS3D. A new haul plan needs to be created (Figure 4).

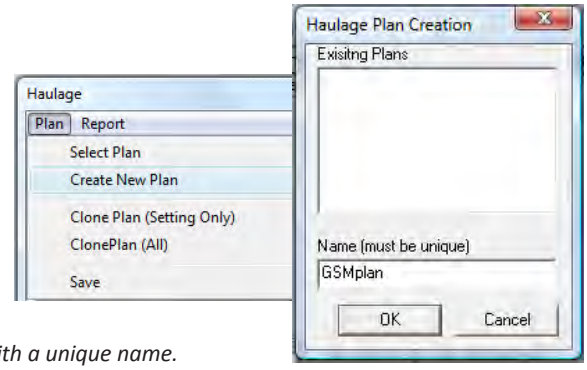

Figure 4. Create a new haulage plan with a unique name.

There are three types of outputs that can be provided by MSHaulage. They are listed in the **Report** menu. The first type is the network profile. The network profile is the geometry and physical coordinates of the road network. The information required for this is the location points, road segments, and equipment information. The Haul, Location Nodes, Route Segments, Load/Haul Equip, Equip Sets, and Equip Speeds tabs must be populated (Figures 5 and 6).

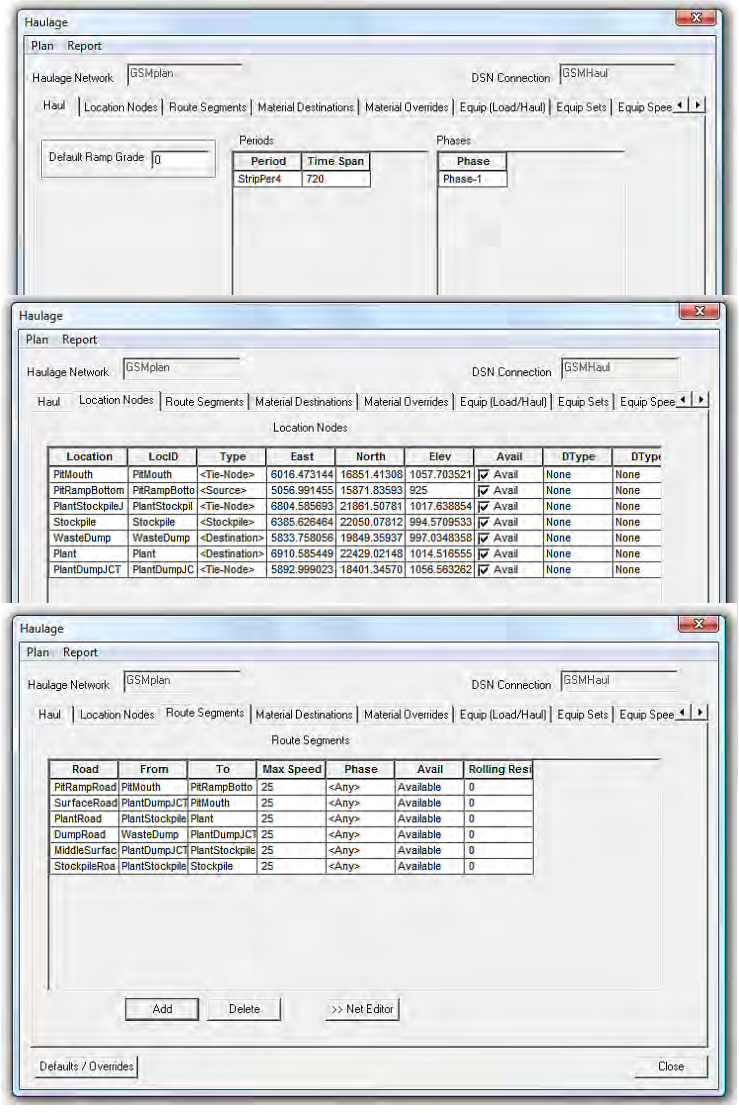

Figure 5. Haulage panels to populate for network profiles.

The second type of output is cycle times. Cycle times are calculated between every source point and every destination point. Note that stockpiles act as both a source and a destination. MSHaulage will calculate the quickest possible haul route adhering to the road constraints (e.g., one way road segments, etc.). The additional information required for this is the equipment specifications for speeds, incurred times for a given cycle, and additional distances at destination points (e.g., dump lift distances). The **Network Editor**, **Load/Haul Equip**, **Equip Sets**, and **Equip Speeds** tabs are used to provide this additional information. The cycle times will be output to a cycle time file.

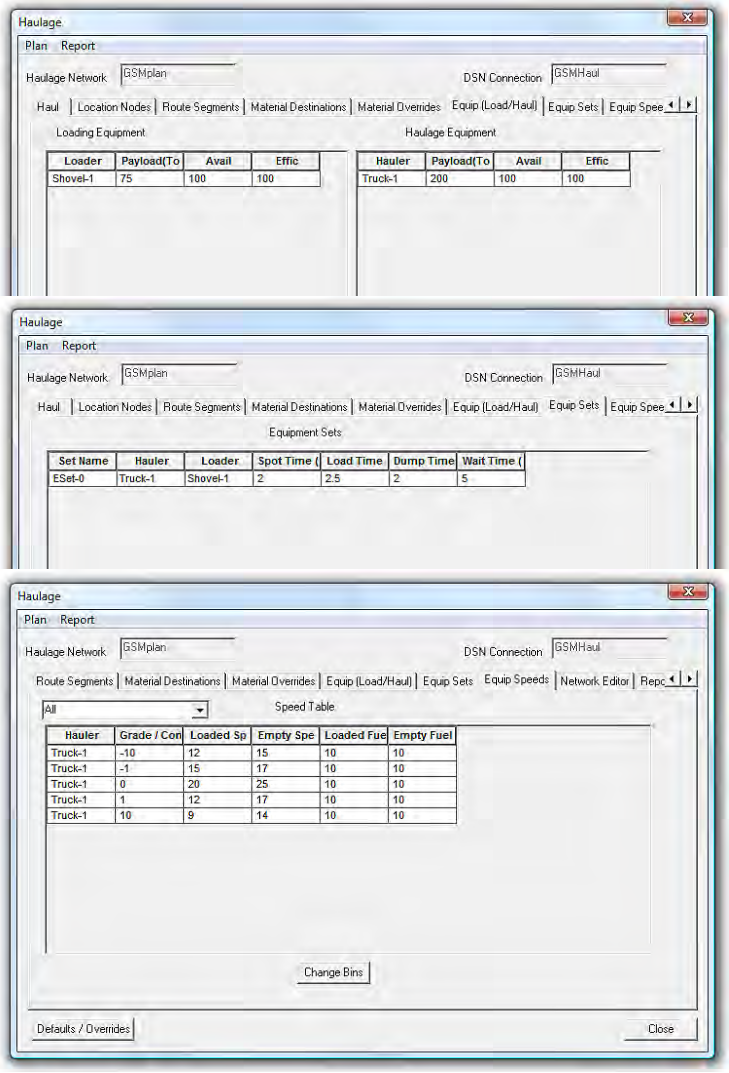

Figure 6. MSHaulage panels populated for cycle time generation.

The third type of output is material routing. In order to route material, cuts (digitized sections of material) need to be made and stored in the MSPD. MineSight® Interactive Planner (MSIP) is used to make cuts and can calculate the cut reserves for the coal seam. The MSIP plan can have varying levels of complexity with multiple seams. For the purpose of this article, strips cuts along one seam will best illustrate the functionality of MSHaulage with MSIP cuts using a gridded surface model. Cuts have been made along the active dragline strip (Figure 7). It should be noted that while the dragline removes the overburden, trucks and shovels are used to remove the coal and sometimes the partings. The mining cuts can be attributed in the database for the mining area and period identification. Spoil piles have been included in the pit modeling and have been made into solids. The cuts follow the north pit wall for strip period four and progresses west to east.

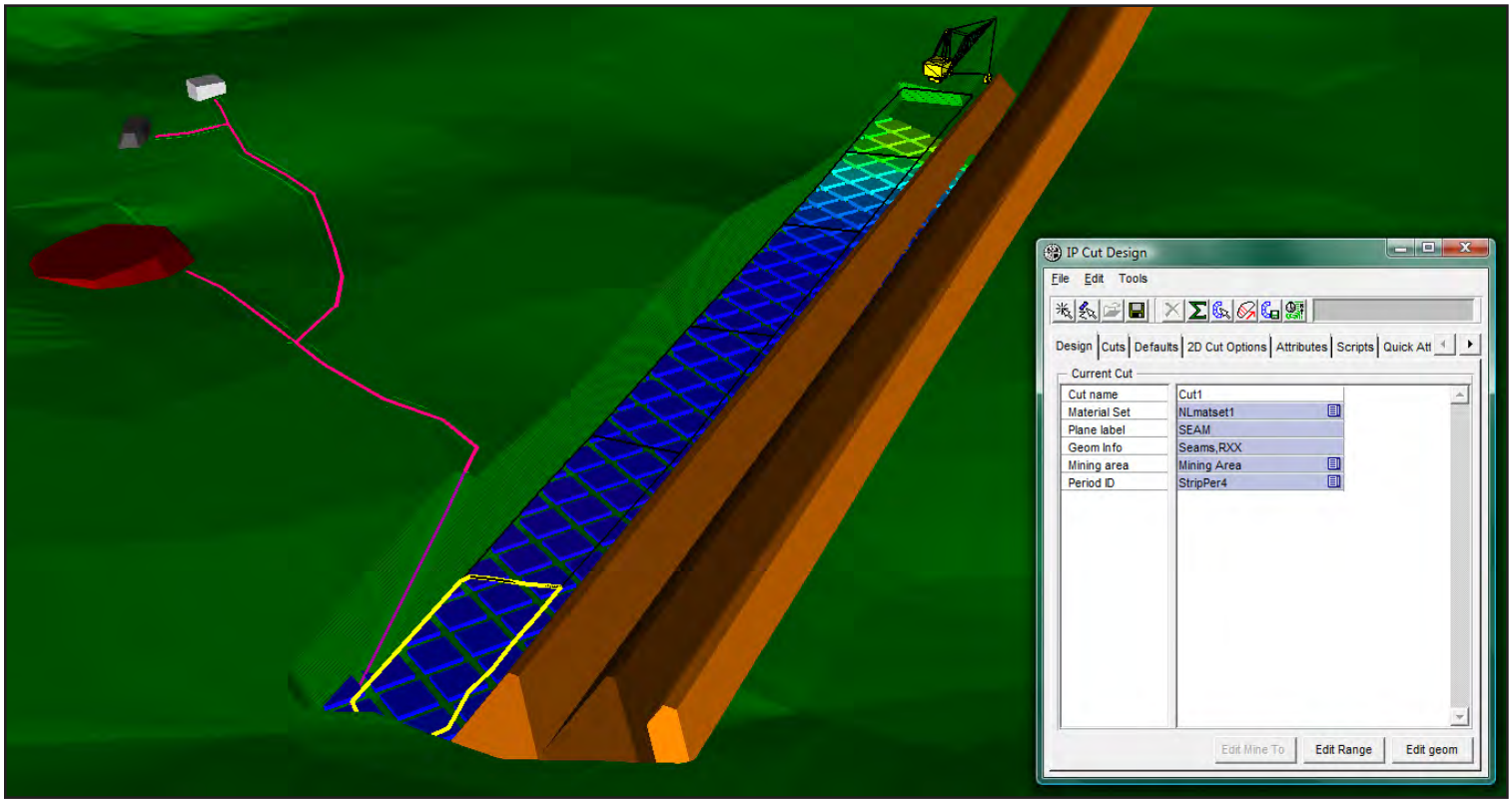

Figure 7. GSM dragline mining along strip period 4 in reference to the haulage network. The cuts are placed on the top of the seam for illustrative purposes.

To have the cuts routed accurately the best practice is to create the cuts at the same elevation as the seam (i.e. the level that the trucks would travel to in order to get to the coal seam). MSHaulage cuts will search for the closest source node on the same elevation. If no source nodes exist on the plane of the cut it will pick up the nearest road segment on the same elevation (i.e., ramp road). It will then calculate the horizontal distance from the centroid of the polygon to the point on the road at the same elevation. Also, MSHaulage will use only the portion of the ramp road segment that is contained within the haulage path (e.g., the portion of the road considered might be halfway up the ramp and would omit the lower ramp road distance). MSHaulage uses the same logic for solid cuts and will route based upon the elevation of the centroid of the solid.

With the geometry of the haulage routes determined for each cut, the cycle time and material routing can be calculated and reported. To route these cuts, MSHaulage can import the material set of the MSIP plan. The material cutoffs can then be assigned to a destination type and the material will be routed to the proper destination by the quickest route. The **Material Destination** and **Material Overrides** tabs are finally populated as well as the remainder of the **Location Nodes** tab (Figure 8).

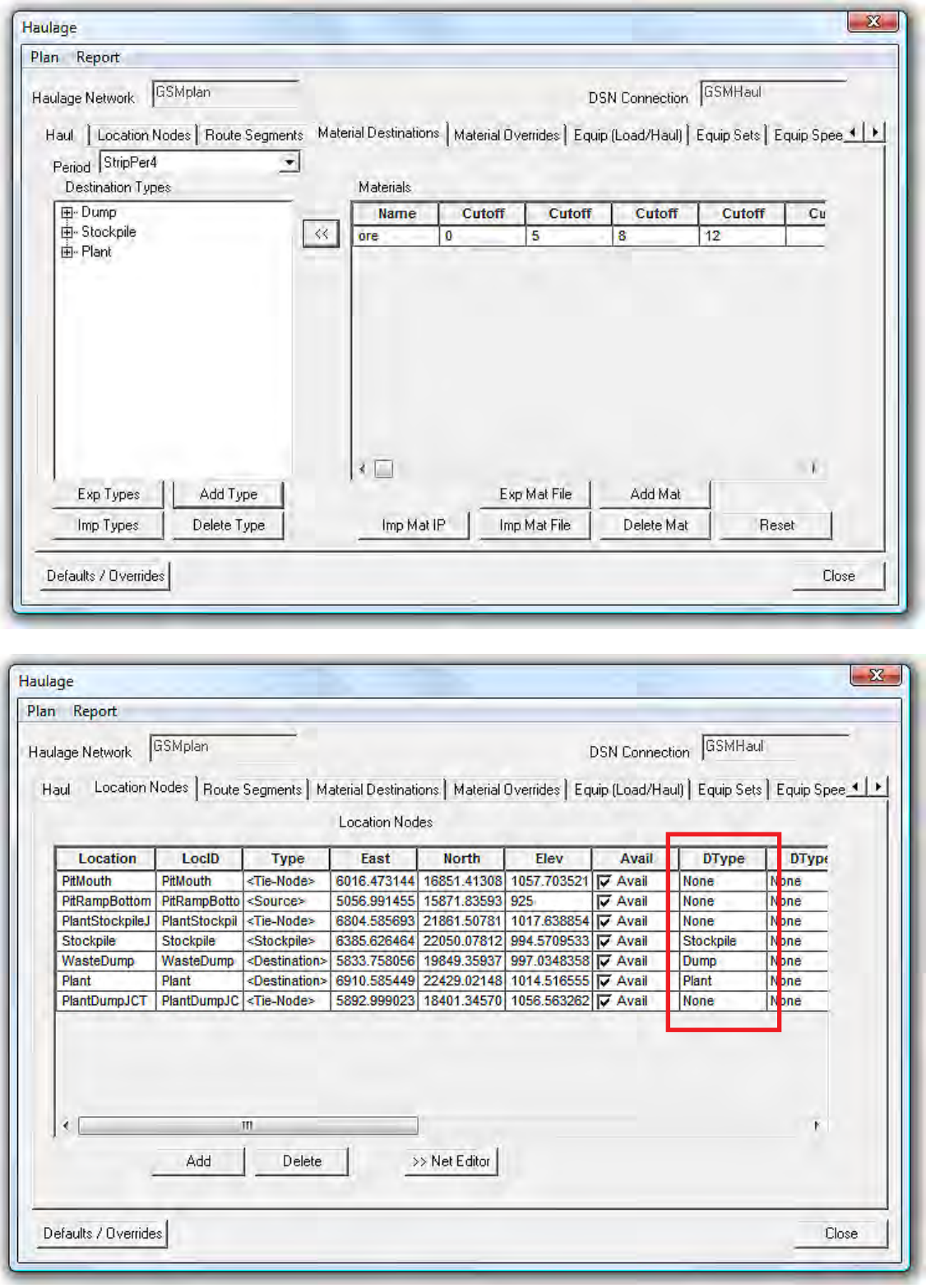

Figure 8. Haulage tabs to be populated for material routing.

Lastly, after running the material routing from the Report menu, the Report Editor tab automatically previews the material routing report (Figure 9). The report can then be saved to a CSV file and/or the material routing information can be saved to the MSPD.

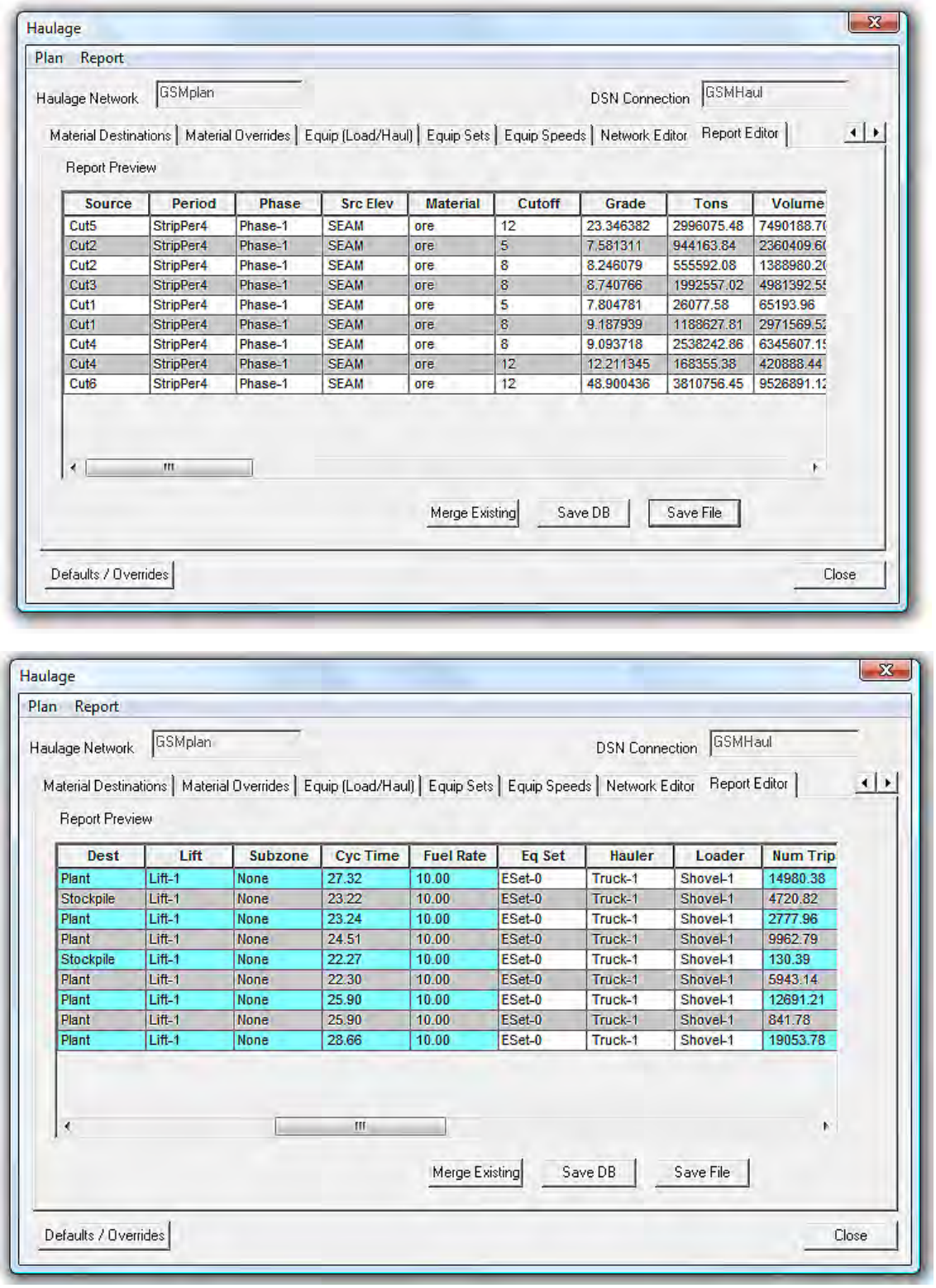

Figure 9. Material routing report preview on the report editor tab.

MSHaulage can be utilized in many varying applications from open pit metal deposits, to coal and underground operations. For additional help populating the MSHaulage tabs (i.e., importing and formatting), refer to the Help documentation for MSHaulage. For further reading, refer to the May 2008 newsletter article “Introducing MineSight Haulage”.