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Prepared in cooperation with the Idaho Department of Environmental Quality,
Basin Environmental Improvement Commission, and the
U.S. Environmental Protection Agency

Simulation of Flow, Sediment Transport, and Sediment Mobility of the Lower Coeur d'Alene River, Idaho

Scientific Investigations Report 2008–5093

U.S. Department of the Interior
U.S. Geological Survey

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Conversion Factors, Datums, and Abbreviations and Acronyms

Inch/Pound to SI

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
cubic yard (yd^3)	0.7646	cubic meter
foot (ft)	0.3048	meter
foot per foot (ft/ft)	1.0	meter per meter
foot per second (ft/s)	0.3048	meter per second
foot per squared second (ft/s^2)	0.305	meter per squared second
inch (in.)	2.54	centimeter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
Pascal (Pa)	1.0	Newtons per square meter
pound per cubic foot (lb/ft^3)	0.00000624	milligram per liter
pound per foot-squared second [$lb/(ft\text{-}s^2)$]	1.488	Newtons per square meter
square mile (mi^2)	2.590	square kilometer
ton	907.185	kilogram
ton	0.907	metric ton
ton per day (ton/d)	0.01050	kilogram per second

SI to Inch/Pound

Multiply	By	To obtain
gram (g)	0.03527	ounce, avoirdupois
kilogram per cubic meter (kg/m^3)	0.063	pound per cubic feet
kilogram per meter per squared second [$kg/(m\text{-}s^2)$]	1.0	Newtons per squared meter
meter (m)	3.281	foot
meter per second (m/s)	3.281	foot per second
meter per second squared (m/s^2)		foot per second squared
millimeter (mm)	0.039	inch
Newtons per square meter (N/m^2)	0.6719	pound per foot squared per second
Newtons per square meter (N/m^2)	1.0	Pascal (Pa)
square meter per second (m^2/s)	1.076	square foot per second

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32.$$

Concentrations of suspended sediments in water are given in milligrams per liter (mg/L).

Datums

Vertical coordinate information refers to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information refers to the North American Datum of 1983 (NAD 83).

National Geodetic Vertical Datum of 1929 (NGVD 29) refers to a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada.

Lake datum is vertical datum used by the AVISTA Corporation and others in the Coeur d'Alene area. To obtain elevations in NAVD 88, add 0.80 ft to lake datum elevations.

Conversion Factors, Datums, and Abbreviations and Acronyms—Continued

Abbreviations and acronyms

Abbreviations and acronyms	Meaning
1D	one-dimensional
2D	two-dimensional
2.5D	two and one-half dimensional
ADVM	acoustic Doppler velocity meter
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
LIDAR	Light Detection and Ranging
M1 curve	backwater curve
M2 curve	free-flowing water curve (above critical depth)
MAD	mean absolute difference
MD	maximum difference
MD_SWMS	Multi-Dimensional Surface Water Modeling System
NAIP	National Agriculture Imagery Program
NF	North Fork
RM	river mile
SF	South Fork
SI	International System
USGS	U.S. Geological Survey
WY	water year

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Simulation of Flow, Sediment Transport, and Sediment Mobility of the Lower Coeur d’Alene River, Idaho

By Charles Berenbrock and Andrew W. Tranmer

Abstract

A one-dimensional sediment-transport model and a multi-dimensional hydraulic and bed shear stress model were developed to investigate the hydraulic, sediment transport, and sediment mobility characteristics of the lower Coeur d’Alene River in northern Idaho. This report documents the development and calibration of those models, as well as the results of model simulations.

The one-dimensional sediment-transport model (HEC-6) was developed, calibrated, and used to simulate flow hydraulics and erosion, deposition, and transport of sediment in the lower Coeur d’Alene River. The HEC-6 modeled reach, comprised of 234 cross sections, extends from Enaville, Idaho, on the North Fork of the Coeur d’Alene River and near Pinehurst, Idaho, on the South Fork of the river to near Harrison, Idaho, on the main stem of the river. Bed-sediment samples collected by previous investigators and samples collected for this study in 2005 were used in the model. Sediment discharge curves from a previous study were updated using suspended-sediment samples collected at three sites since April 2000. The HEC-6 was calibrated using river discharge and water-surface elevations measured at five U.S. Geological Survey gaging stations. The calibrated HEC-6 model allowed simulation of management alternatives to assess erosion and deposition from proposed dredging of contaminated streambed sediments in the Dudley reach. Four management alternatives were simulated with HEC-6. Before the start of simulation for these alternatives, seven cross sections in the reach near Dudley, Idaho, were deepened 20 feet—removing about 296,000 cubic yards of sediments—to simulate dredging.

Management alternative 1 simulated stage-discharge conditions from 2000, and alternative 2 simulated conditions from 1997. Results from alternatives 1 and 2 indicated that about 6,500 and 12,300 cubic yards, respectively, were deposited in the dredged reach. These figures represent 2 and 4 percent, respectively, of the total volume of dredged sediments removed before the start of simulation.

In alternatives 3 and 4, the incoming total sediment discharges from the South Fork of the river were decreased by one-half. Management alternative 3 simulated stage-discharge conditions from 2000, and alternative 4 simulated conditions from 1997. Reducing incoming sediment discharge from the South Fork did not affect the streambed and deposition in the Dudley and downstream reaches, probably because the distance between the South Fork and the Dudley reach is long enough for sediment supply, transport capacity, and channel geometry to be balanced before reaching the Dudley and downstream reaches.

Development and calibration of a multi-dimensional hydraulic and bed shear stress model (FASTMECH) allowed simulation of water-surface elevation, depth, velocity, bed shear stress, and sediment mobility in the Dudley reach (5.3 miles). The computational grid incorporated bathymetric and Light Detection and Ranging (LIDAR) data, with a node spacing of about 2.5 meters.

With the exception of the fourth FASTMECH calibration simulation, results from the FASTMECH calibration simulations indicated that flow depths, flow velocities, and bed shear stresses increased as river discharge increased. Water-surface elevations in the fourth calibration simulation were about 2 feet higher than those in the other simulations because high lake levels in Coeur d’Alene Lake caused backwater conditions. Average simulated velocities along the thalweg ranged from about 3 to 5.3 feet per second, and maximum simulated velocities ranged from 3.9 to 7 feet per second. In the dredged reach, average simulated velocity along the thalweg ranged from 3.5 to 6 feet per second. The model also simulated several back-eddies (flow reversal); the largest eddy encompassed about one-third of the river width. Average bed shear stresses increased more than 200 percent from the first to the last simulation. Simulated sediment mobility, assessed using bed shear stress, showed substantial transport of very coarse sand to fine gravel in these simulations. Areas of greater sediment mobility occurred near the thalweg, and areas of lesser mobility occurred near the banks and back-eddies.

Introduction

The Coeur d’Alene River flows in a westerly direction from its headwaters in the mountainous, coniferous forests near the Idaho-Montana border to its outlet in Coeur d’Alene Lake (fig. 1). The North Fork (NF) and South Fork (SF) Coeur d’Alene Rivers converge downstream of the town of Enaville, Idaho. From there, the main stem Coeur d’Alene River flows about 35 mi westward where it empties into Coeur d’Alene Lake. The Coeur d’Alene River terminates at the inlet to the lake; the lake’s outlet is on its north end and forms the beginning of the Spokane River. The Post Falls Dam is about 9 mi downstream of the lake (fig. 1). The dam regulates the Coeur d’Alene Lake water level from mid-June to mid-November. The Spokane River continues flowing westerly through Idaho and part of Washington, passing through several dams before joining the Columbia River at Franklin D. Roosevelt Lake (fig. 1).

More than 100 years of mining in the upper Coeur d’Alene River basin have resulted in the transport and deposition of large quantities of metal-enriched sediments into the lower Coeur d’Alene River and onto its floodplain. The SF Coeur d’Alene River flows through the Coeur d’Alene Mining District, one of the world’s largest producers of silver and one of the Nation’s largest producers of lead and zinc (Long, 1998). Mining produced more than 130 million tons of lead-zinc-silver sulfide ores from the district since the mid-1880s (Long, 1998). From the 1880s to 1968, mine waste (tailings) was dumped into the river (Ellis, 1940). The river carried the tailings downstream, especially during moderate to high flows, and deposited them in the lower reaches. Previous studies have shown that the highest concentrations of contaminated sediments are in the streambed. The sediments are entrained and redistributed during high-flow events (Bookstrom and others, 1999; Box and others, 2001; Box and others, 2005). Some of the highest concentrations of lead in the streambed were detected in the reach near Dudley, Idaho (Bookstrom and others, 2004). During times of flooding, metal-enriched sediments are deposited and (or) remobilized in the flat lower Coeur d’Alene River valley (Cataldo to Harrison) and its floodplain. The flood history of the lower valley—1933, 1949, 1956, 1964, 1974, 1995, 1966, and 1996 (Woods and Beckwith, 1997; and Box and others, 2005)—includes the most recent large peak flow, which occurred in 1996.

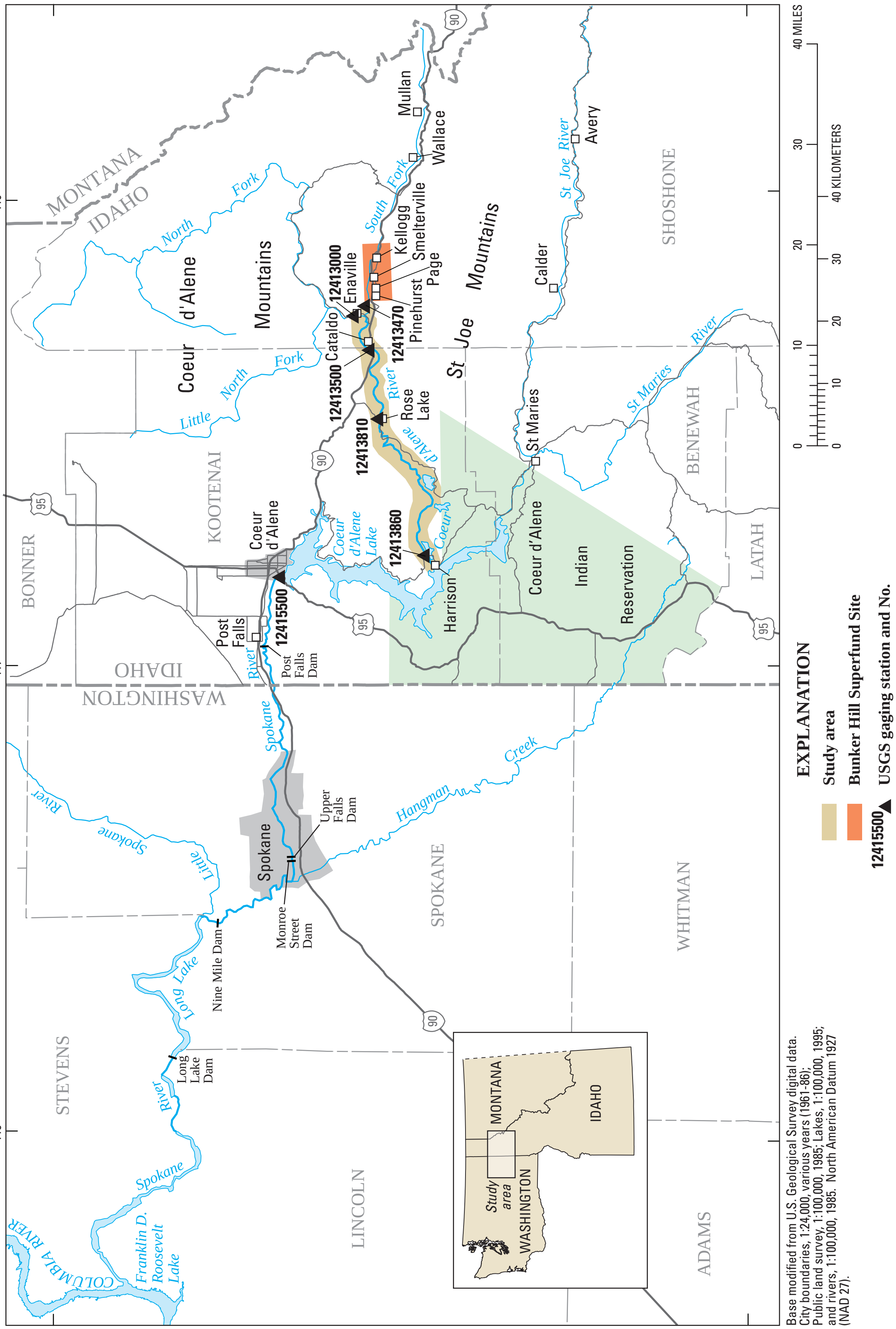
The Coeur d’Alene River flows naturally because no dams or major diversion structures lie upstream of Coeur d’Alene Lake. Eleven peak flows greater than 30,000 ft^3/s occurred before 2005, as measured at the U.S. Geological Survey (USGS) Coeur d’Alene River near Cataldo gaging station (12413500). The largest peak flow (79,000 ft^3/s) was measured on January 16, 1974. A peak flow of 70,000 ft^3/s was measured during the most recent large flood on February 9, 1996 (Brennan and others, 2006; updated from Beckwith and Berenbrock, 1996). Average spring runoff for the period of record is about 15,000 ft^3/s, and summer discharges usually are less than 600 ft^3/s. The annual mean discharge for the period of record is about 2,500 ft^3/s. Without flood control structures in the channel, periodic flooding of the lower valley occurred naturally during high flow events. This led to the construction of levees in flood prone areas to protect resources, the railroad, and nearby communities. These levees, especially in the lower valley, have limited the lateral movement of the river. River discharges must exceed 20,000 ft^3/s to overtop levees and overflow riverbanks.

The Post Falls Dam creates a backwater effect in the Coeur d’Alene River that reaches upstream to Mission Flats (fig. 2). This backwater effect, in turn, decreases the river’s energy gradient and flow velocity, which affects erosion and sediment transport processes. Sediments move downstream from upper reaches of the basin to the lower energy gradient reaches of the lower Coeur d’Alene River valley. Decreased velocities in the lower valley limit the river’s ability to meander and change course, and decrease the transport of sediments. For floods at bankfull and less, sediment transport takes place only in the river. Sediments are mobilized and transported downstream in the streambed. When the river banks are overtopped, sediments in the river and the floodplain remobilize and move downstream.

Sediment transport is a physical process that depends on many hydraulic factors in the river and surrounding areas. The Coeur d’Alene River transports sediments and unconsolidated material from the streambed, banks and floodplain. Upstream of river mile (RM) 159.8 near Mission Flats, the streambed is composed mostly of gravels and cobbles. Downstream of RM 159.8, the composition is mostly sands and silts. These sediments vary in their degree of mobility.

The USGS, in cooperation with the Idaho Department of Environmental Quality, Basin Environmental Improvement Commission, and the U.S. Environmental Protection Agency developed flow hydraulic and sediment-transport models of the Coeur d’Alene River between Enaville and Pinehurst, Idaho to Coeur d’Alene Lake near Harrison, Idaho. These models will help improve the understanding of streamflow, hydraulics, bed shear stress, erosion and deposition, and sediment-transport processes. The models also will provide insight into the effects of proposed recovery actions in the river.

One model, a one-dimensional (1D) sediment-transport model, encompasses the reach beginning upstream at the streamflow-gaging stations on the NF Coeur d’Alene River at Enaville (12413000) and the SF Coeur d’Alene River near Pinehurst (12413470) and ending at the gaging station on the Coeur d’Alene River near Harrison (12413860) near the inlet to the lake. This model incorporated 234 cross sections, about 1,000 ft apart, in the reaches downstream of Mission Flats (fig. 2) and at variable intervals (200–2,000 ft) upstream to the Enaville and Pinehurst gaging stations.



Base modified from U.S. Geological Survey digital data.
City boundaries, 1:24,000, various years (1961-86);
Public land survey, 1:100,000, 1985; Lakes, 1:100,000, 1995;
and rivers, 1:100,000, 1985. North American Datum 1927
(NAD 27).

Figure 1. Location of study area and U.S. Geological Survey gaging stations, Coeur d'Alene River basin, Idaho.

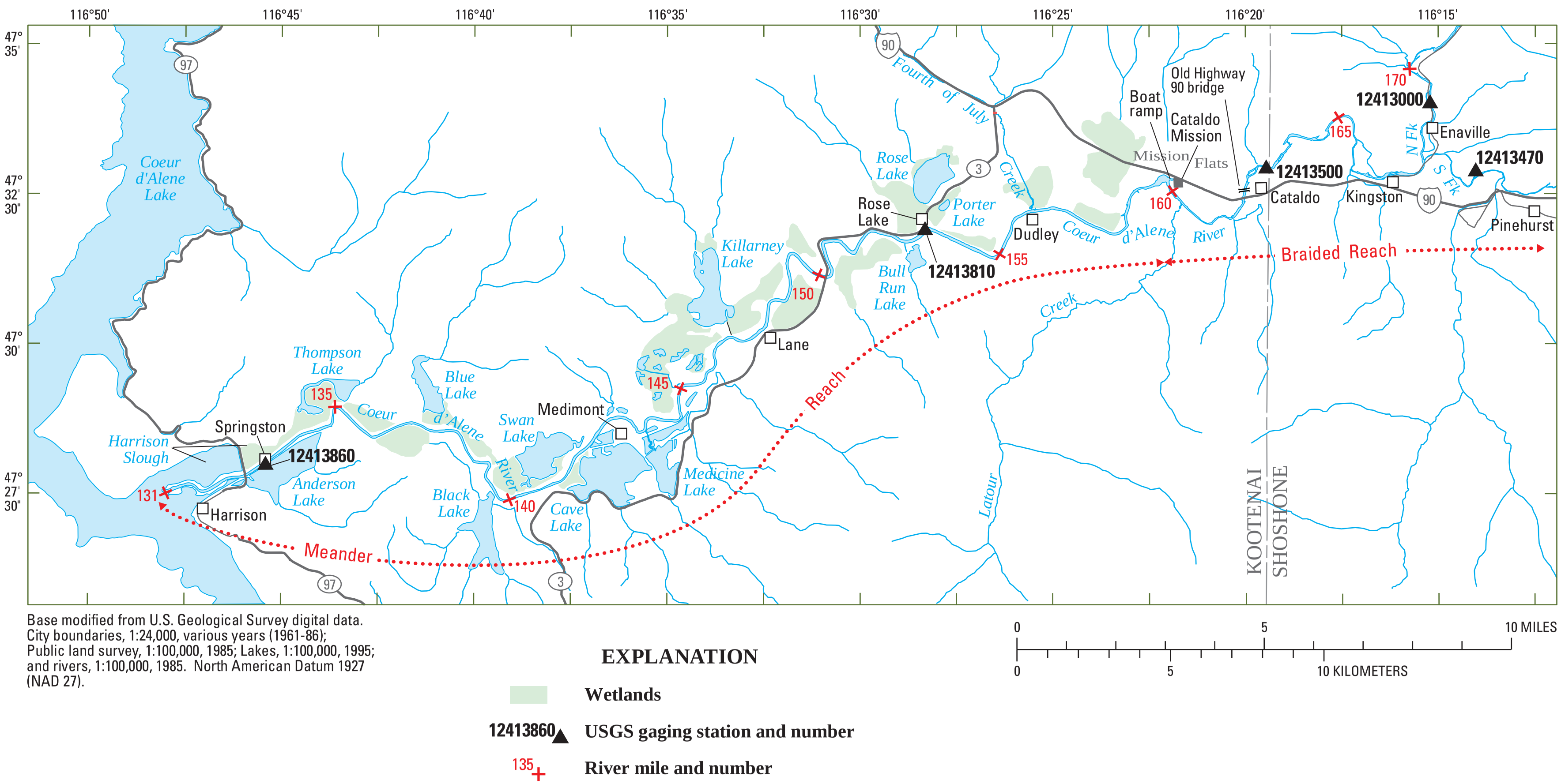


Figure 2. Location of study area, U.S. Geological Survey gaging stations, river miles, and lateral lakes, Coeur d'Alene River basin, Idaho.

The USGS also developed a multi-dimensional hydraulic and bed shear stress model for a smaller reach in the lower valley near Dudley. This model was used to simulate flow hydraulics and sediment mobility potential based on shear stress and bedform geometry in the lower Coeur d'Alene River. The study reach contains highly contaminated streambed sediments; part of the streambed in this reach may be removed by dredging because of the contaminated sediments (Bookstrom and others, 2004).

Purpose and Scope

This report documents the development and calibration of a 1D sediment-transport model and a multi-dimensional hydraulic and bed shear stress model of the lower Coeur d'Alene River. The study reach (figs. 1 and 2) encompasses the lower Coeur d'Alene River from Enaville and Pinehurst to about Coeur d'Alene Lake, with a detailed focus in the Dudley reach near Rose Lake (fig. 2). Understanding the hydraulic and sediment-transport characteristics of the Dudley reach is of primary interest because of proposed dredging to remove contaminated streambed sediments (Bookstrom and others, 2004).

The scope of this report (1) defines flow types, river stages, river discharge, channel geometry, streambed sediments, and total sediment load; (2) documents the development and calibration of models of the study reach; and (3) examines the use of these models to simulate the response of the hydraulic and sediment system to river discharges, lake levels, and sediment input scenarios. The model simulation results can help facilitate the evaluation of the feasibility and potential effects of remedial actions (management alternatives) on the streambed.

The 1D sediment-transport model used in this study simulates a movable streambed, in contrast to many models in which the streambed is fixed and does not change. This 1D sediment-transport model averages parameters across the cross sections and calculates erosion, deposition, and sediment transport. One-dimensional models usually require less setup, run-time, and data than two-dimensional (2D) models. However, 2D models are able to simulate uneven water surface elevations, varying velocities, and flows in more than one direction in a cross section. For example, a 2D model that incorporated sediment transport was used to describe erosion and deposition of the Kootenai River in Idaho and the Platt River in Colorado (McDonald and others, 2006; Nelson and others, 2006).

Description of Study Reach

The Coeur d'Alene River originates in the upper part of the Coeur d'Alene and St. Joe Mountains near the Idaho-Montana border and flows westward into Coeur d'Alene Lake (fig. 1). The river basin drains an area of about 1,475 mi^2 and consists of two main branches of the Coeur d'Alene River, the North Fork (NF) and the South Fork (SF). These branches converge at RM 167.7 and then follow a sinuous path to the lake. The river crosses through Shoshone and Kootenai Counties, passing a few old mining and logging towns along the way. The study reach is about 35 mi long—starting upstream of Enaville on the NF and downstream of Pinehurst on the SF to Springston to about 1.5 mi upstream from the inlet to Coeur d'Alene Lake (fig. 2).

The Coeur d'Alene Mountains, at the headwaters of the river, reach elevations of 6,650 ft. The lowest point in the study area (2,128.8 ft at normal summer levels) is at the Coeur d'Alene River inlet to the lake, (NAVD 88 datum; Avista Corporation, 2005, p. B-2). The St. Joe Mountains near Cataldo reach elevations of 6,400 ft. These mountains are part of the Bitterroot Range, and consist of high forested peaks and steep intermontane valleys that cut through thick deposits of volcanic ash and metasedimentary rock. The study area is in the Coeur d'Alene metasedimentary zone (McGrath, 2002). Fractured quartzite and argillaceous rocks of Precambrian age underlie the study area (McGrath, 2002). Alluvium of Holocene and Pleistocene fills the valley and consists of unconsolidated fluvial and lacustrine deposits. The percentage of lacustrine deposits (silts and clays) increases toward the lake.

Vegetation changes with elevation. Only northern climate flora exists in the riparian zones. The valley areas consist of agricultural and open range land, wetlands, and lakes. Tree density in the valley becomes sparse with grasses and scrub vegetation dominating, especially in and around the wetlands and lateral lakes. Tree species include conifers, cottonwoods, willow, aspen, and birch. The lateral lakes feature a large variety of aquatic plants that provide habitat for avian and amphibious species. Around the turn of the 20th century, modification of natural levees formed by the river altered the hydrologic regime, and the reclaimed wetlands allowed for expansion of farming and cattle operations in the valley. At higher elevations, the study area primarily consists of coniferous forest comprised of Douglas fir, white pine, grand fir, western red cedar, and western hemlock. Mountain hemlock, subalpine fir, Engelmann spruce, and white bark pine dominate farther up the mountains.

The river is unrestricted by any dam or flood control structures upstream of Coeur d'Alene Lake and is subject to seasonal and peak flows. The annual historical mean flow for the main stem of the Coeur d'Alene River near Cataldo (RM 162.9) is about 2,500 ft^3/s. Precipitation in the basin is highly variable due to orographic effects in the upper reaches—annual averages range between 26 and 40 in. of rain and 50 to 70 in. of snow. High flows in the winter can occur when heavy, warm rains from the Pacific Ocean rapidly melt the snowpack in the basin. The rapid snowmelt and heavy rains abruptly increase runoff from low winter base flows to high flows as during the winter high flows of 1995, 1996, and 1997 (Box and others, 2005). In contrast, gradual melting of snow in the basin causes a slow rising and falling runoff curve (hydrograph) for spring, represented by flows from April through June 1997 (Box and others, 2005). Warm days and spring rainstorms cause small sharp peaks on the hydrograph, represented by flows from April through June 2006.

Interstate Highway 90 lies to the north and to some extent is parallel to the river until it reaches Cataldo where it follows the SF eastward toward Wallace. The Union Pacific Railroad, recently converted to a bicycle trail in the "Rails to Trails" Program, borders the river. Elevation of the bicycle trail usually is above the floodplain and acts like a levee restricting flooding.

The floodplain starts at the confluence of the NF and SF near Enaville and extends to Coeur d'Alene Lake. The floodplain width varies with the local topography and ranges from about 1,000 ft at the confluence of the NF and SF (RM 167.7) to more than 3 mi near Dudley and Rose Lake. From Dudley, the floodplain narrows to about 1 mi near Lane, then widens to about 2 mi near Medimont, and narrows again at State Highway 97 to about 1 mi (fig. 2).

Downstream of Cataldo, wetlands and lateral lakes border the Coeur d'Alene River (fig. 2). Eleven lakes and numerous adjoining wetlands are in the floodplain. These areas provide habitat for various aquatic and terrestrial species including zooplankton, amphibians, fish, muskrats, and beavers, as well as local and migratory fowl. Based on average depth, two of the lateral lakes (Black and Blue) are deeper than 20 ft, and six lakes (Anderson, Thompson, Swan, Killarney, Rose, and Porter) are between 10 and 20 ft deep. Three lakes (Cave, Medicine, and Bull Run) are less than 10 ft deep (U.S. Fish and Wildlife Service, written commun., 2006). Most wetlands have depths of 5 ft or less. Inundation of the floodplain occurs at varying discharges due to lateral lake and wetland expansion as well as overtopping of the levee system. Lateral lakes with connecting inlet channels provide hydraulic connectivity with the river. The wetlands and lateral lakes also act as terminal or semi-terminal sinks for the contaminated sediments.

The levee system extends from the town of Cataldo downstream to the outlet at Coeur d'Alene Lake, with an average height of 7.5 ft. The original levees formed naturally from sediment deposition during floods when the river flowed out of its banks. These natural levees were highest near Cataldo and decreased in height in the downstream direction. The levee system changed as the valley population increased and land use changed. Many levees were artificially raised during the early 1900s to reclaim land for agriculture and cattle grazing. The Union Pacific Railroad Company also enhanced the levees along the southern edge of the river to support a rail line to the mining camps and mills. These levees constrained the river's natural meandering course and stabilized the once dynamic riparian ecosystem.

Two major geomorphic reaches were identified in the study reach: a braided reach and a meandering reach (Bookstrom and others, 1999; Box and others, 2005). The braided reach includes the SF and NF and the main stem to RM 159.8 near Mission Flats (fig. 2). In the study area, the braided reach is about 11 mi long, and the river usually consists of multiple channels. Composition of the streambed is mostly gravels and cobbles. Gravel bars and terraces also are present along this reach. Considerable quantities of fines (clay, silt, and sand) also may be present in the SF and in the main stem because of poor mine-waste practices in the upper SF basin. Overall, the braided reach is a gravelbed river with median particle sizes (d_{50}) ranging from 54 mm on the NF, 19 mm on the SF, and 23 mm on the main stem (Borden and others, 2004). The surface layer of the streambed between Latour Creek (RM 160.340) and RM 159.8 (end of the braided reach) has a pavement of overlapping cobbles. Upstream of Latour Creek, the armored surface layer has mixed amounts of sands, gravels, cobbles, and boulders. The NF produces natural quantities of sediment from a relatively pristine upper basin. However, the SF produces excessive quantities of metal-contaminated fines—lead, zinc, silver, antimony, arsenic, cadmium, and copper (Woods and Beckwith, 1997; Bookstrom and others, 1999; and Bookstrom and others, 2001; Woods, 2001). Mean annual discharge from the NF (about 1,900 ft^3/s) is about 4 times greater than from the SF (about 510 ft^3/s) (Brennan and others, 2006). Whereas, total sediment load from the SF is about 20 times greater than from the NF (Clark and Woods, 2001). Average flow depths in the braided reach usually are less than 10 ft, and water-surface slope is about 6.5×10^{-4} ft/ft.

The meander reach of the Coeur d'Alene River is a single channel with gentle bends, although the bends at RM 135.25 and from RM 149 to 152 are sharp. The meander reach covers the main stem from RM 159.8 at Mission Flats to the Coeur d'Alene River inlet (RM 131) to the lake, a distance of about 29 mi. This reach cuts through a nearly flat floodplain, and channel widths vary between 200 and 350 ft. This reach is relatively stable due to the river location, levees, and railroad embankments that limits the lateral migration of the river. The streambed consists primarily of silts and sands (Bookstrom and others, 1999), and d_{50} ranges from 0.25 to 0.10 mm. Over time, these fine, heavy metal-contaminated sediments from mine tailings settled in the meander reach. Contaminated sediments were detected to a depth of about 10 ft below the river bottom and in meander point bars (Box and others, 2001; Bookstrom and others, 2004). Flow velocities are low in this reach because of backwater conditions. Average flow depths in the meander reach usually are 20 ft, and water-surface slope is about 6.5×10^{-5} ft/ft, about 10 times flatter than the braided reach.

Calibration of the 1D model used stage or flow information from five USGS gaging stations in the study reach (fig. 2): Coeur d'Alene River near Harrison (12413860), at Rose Lake (12413810), and at Cataldo (12413500); NF Coeur d'Alene River at Enaville (12413000); and SF Coeur d'Alene River near Pinehurst (12413470). The Cataldo gaging station has been in continuous operation since 1920; Enaville since 1939, Pinehurst since 1987, and Harrison since 1991. The Rose Lake gaging station was in operation from 1994 to 2000. Only stage data are available at the Harrison and Rose Lake gaging stations because of backwater conditions at the sites. Discharge is not a function of stage alone in backwater conditions. A 1D hydraulic-flow model (Woods and Beckwith, 1997) based on water-surface elevation data for the Harrison gaging station and discharge data for the Cataldo gaging station was used to estimate discharge at the Harrison gaging station. An acoustic Doppler velocity meter (ADVM) was installed at the Harrison gaging station on February 25, 2004. A velocity-stage-discharge relation has been used since March 2004 to determine discharge. Morlock and others (2002) provide a more complete discussion on computing discharge at sites using ADVMs. Discharges for the Cataldo, Enaville, and Pinehurst gaging stations are calculated by a stage-discharge relation.

Previous Investigations

Since 1981, four surface-water models have been developed for the Coeur d'Alene River from Enaville and Pinehurst to the lake near Harrison. Each model was developed for a unique purpose; therefore, each poses its own drawbacks and limitations.

FEMA Model (1981)

In 1981, the Federal Emergency Management Agency (FEMA) completed the first model of the lower Coeur d'Alene River for a flood insurance study (Federal Emergency Management Agency, 1979, and 1982). This model delineated the 100-year floodplain. The 100-year flood has a 1 percent chance of occurring in a given year. Discharge for the 100-year flood is 69,000 ft^3/s at the Cataldo gaging station (12413500) (updated from Berenbrock [2002] through 2007 [n = 76]). For the area between Coeur d'Alene Lake and Interstate Highway 90, elevations and delineation for the 100-year flood were based on high-water marks from the 1974 flood and from USGS topographic maps (1:24,000 scale) (Federal Emergency Management Agency, 1979, 1982). Field surveys and aerial photographs from near Interstate Highway 90 and upstream were used to develop a HEC-2 model and obtain cross sections. Bridges in the study reach also were surveyed. The FEMA model was calibrated using the high-water marks from the 1974 flood and other floods. Manning's *n* roughness coefficients ranged from 0.025 to 0.035 for the main channel and 0.030 to 0.045 for the floodplain (Federal Emergency Management Agency, 1979, 1982). For the NF reach, coefficients of 0.040 were used for the main channel and ranged from 0.075 to 0.090 for the floodplain. For the SF reach, coefficients ranged from 0.035 to 0.065 for the main channel and 0.050 to 0.175 for the floodplain.

USGS Model (1992)

In 1992, the USGS developed a computer model of the lower Coeur d'Alene River using the FourPt program to estimate metal loading to Coeur d'Alene Lake (Woods and Beckwith, 1997). This model extended from the Cataldo to the Harrison gaging stations and comprised about 40 cross sections. The model also simulated the lateral lakes using cross sections. Manning's roughness coefficients of 0.022 and 0.060 were used for the main channel and for the river banks, respectively. The model explicitly determined the discharge entering Coeur d'Alene Lake from the river at the Harrison gaging station. The Rose Lake gaging station provided river discharge data to estimate metal loading in the river and floodplain between the Rose Lake and Harrison gaging stations. Model boundaries used 15-minute discharge data from the Cataldo gaging station and stage data from the Harrison gaging station. However, the model was run using a 5-minute time step for model stability and convergence. The FourPt program (DeLong, and others, 1997) is an unsteady, 1D model for open channels based on the shallow surface-water equations. In backwater reaches, discharge is not a function of stage alone, and stage-discharge relations do not work. There may be many stages for one discharge or many discharges for one stage. FourPt can simulate flow conditions in various regular and irregular channels. The backwater in the river, caused by the lake and Post Falls Dam, prevents developing a unique stage-discharge relation at the Harrison and Rose Lake gaging stations. A model such as FourPt must be used to determine discharges at these backwater sites. No sediment transport was simulated, and the streambed in the model was unmovable (fixed bed). The model was used to determine discharge until 2005, when an ADVM was installed to monitor velocity at the Harrison gaging station.

University of Idaho Model (2004)

In 2004, the University of Idaho Center for Ecohydraulics Research used the MIKE11 model to develop a river model of the Coeur d'Alene River (Borden and others, 2004). This model extended from the Enaville gaging station on the NF Coeur d'Alene River and the Pinehurst gaging station on the SF Coeur d'Alene River to the Harrison gaging station on the main stem. The model used 161 cross sections. Cross sections were extended to include the floodplain by using data from USGS Digital Elevation Models. The lateral lakes also were included in the model as storage basins that required area-elevation tables for each lake. Manning's roughness coefficients used ranged from 0.024 to 0.028 for the main channel and from 0.060 to 0.070 for the floodplain. The model used the 15-minute discharge data from the Enaville and Pinehurst gaging stations and 15-minute stage data from the Harrison gaging station as boundary conditions. The model also used the total sediment load curves from Clark and Woods (2001) at the upstream boundaries (Enaville and Pinehurst gaging stations).

The MIKE11 model simulates 1D unsteady flow in channels. It also can simulate erosion, deposition, and the transport of sediments in channels. Borden and others (2004) simulated two floods—a rain-on-snow flood (February 5–March 9, 1996) and a snowmelt flood (May 21–July 21, 1998) and produced longitudinal and planview animations of these floods. The flood from February 5 to March 9 extended across the valley, especially near Coeur d'Alene Lake.

Golder Associates Model (2005)

In 2005, Golder Associates, Inc. (2005) used the 1D steady-flow model, HEC-RAS, to model the lower Coeur d'Alene River to assess environmental effects of the Post Falls Dam. The purpose of this assessment was to support the license renewal of Avista Corporation's hydroelectric facility at the Post Falls Dam on Coeur d'Alene Lake. The model used cross sections developed every 0.5 mi from river bathymetry data. Only in-channel flows were simulated by the model because ground elevation data for bank tops and floodplain were not available. A Manning's n of 0.030 was assumed for cross sections at all flows. This model was not calibrated to hydraulic or sediment-transport conditions (Golder Associates, Inc., 2005). However, model simulation results were used to estimate flow velocities and to calculate sediment transport and incipient motion characteristics. Results showed that velocities in the river increased as lake levels decreased for a specified discharge, as is typical of backwater conditions. Results also indicated that Post Falls Dam did not significantly affect the transport of sediments in the Coeur d'Alene River.

Reach Characterization

An understanding of flow types, stage, river discharge, hydraulic geometry, and streambed sediments of the Coeur d'Alene River is necessary before developing hydraulic and sediment-transport models.

Flow Types

The elevation of Coeur d'Alene Lake affects the water-surface elevation of the Coeur d'Alene River in the study reach. The lake outlet (Spokane River) is restricted by a narrow, elevated, bedrock gorge—the lake is in a naturally dammed river valley. Post Falls Dam (RM 101.7), about 9 mi downstream of the inlet (fig. 1), augments lake storage and raises lake levels especially during summer. The dam controls lake outflows and levels from mid-June to mid-November (summer and autumn) (Avista Corporation, 2005). Post Falls Dam provides hydroelectric power, flood control, and irrigation supply. The lake and (or) dam cause water to back up (increase water-surface elevation) into the Coeur d'Alene River. When flows are high on the Coeur d'Alene and St. Joe Rivers (main tributaries), the lake level rises because inflow exceeds outflow. As high flows recede, outflows may exceed inflows and the lake level falls.

Two types of flow occur in the Coeur d'Alene River in the study reach—backwater and free-flowing water. Backwater is water backed up or retarded in its course, as compared with its normal or natural condition of flow (free-flowing water), usually caused by a downstream lake or dam or by a channel constriction downstream. Backwater also causes the upstream flow depth to increase. Backwater conditions are prevalent in the Coeur d'Alene River from the mouth to Cataldo Mission. Hypothetical water-surface curves illustrate backwater and free-flowing water conditions (fig. 3). Hydraulic engineers refer to the backwater curve as an M_1 curve and the free-flowing water curve (above critical depth) as an M_2 curve. Woodward and Posey (1941), Chow (1959), and Henderson (1966) describe such curves. Elongating the upstream channel in figure 3, would cause the backwater and free-flowing water curves to converge to the normal-depth curve. At the point where the backwater curve (M_1) approaches or converges to the normal-depth curve, the effects of backwater cease. The normal-depth curve is sometimes called the no-backwater curve (Davidian, 1984). Backwater conditions do not affect any water-surface curve at or below the normal-depth curve. Figure 3 also illustrates that high downstream water-surface elevations cause the convergence point with the normal-depth curve to be farther upstream. When downstream water-surface elevations are high, the influence of backwater on the reach moves upstream.

In natural channels like the Coeur d'Alene River, the curves are not as smooth as shown in figure 3. Flow depth changes from point to point along a channel in response to differences in channel shape, slope, and roughness. Figure 4 shows backwater, normal depth, and free-flowing water curves for the Coeur d'Alene River in the study reach for a model

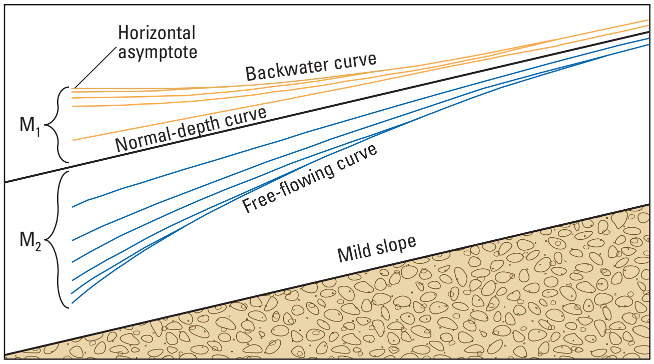


Figure 3. Water-surface curves along a constant, uniform, mild-sloped channel. (Modified from Davidian, 1984, fig. 10, p. 8.)

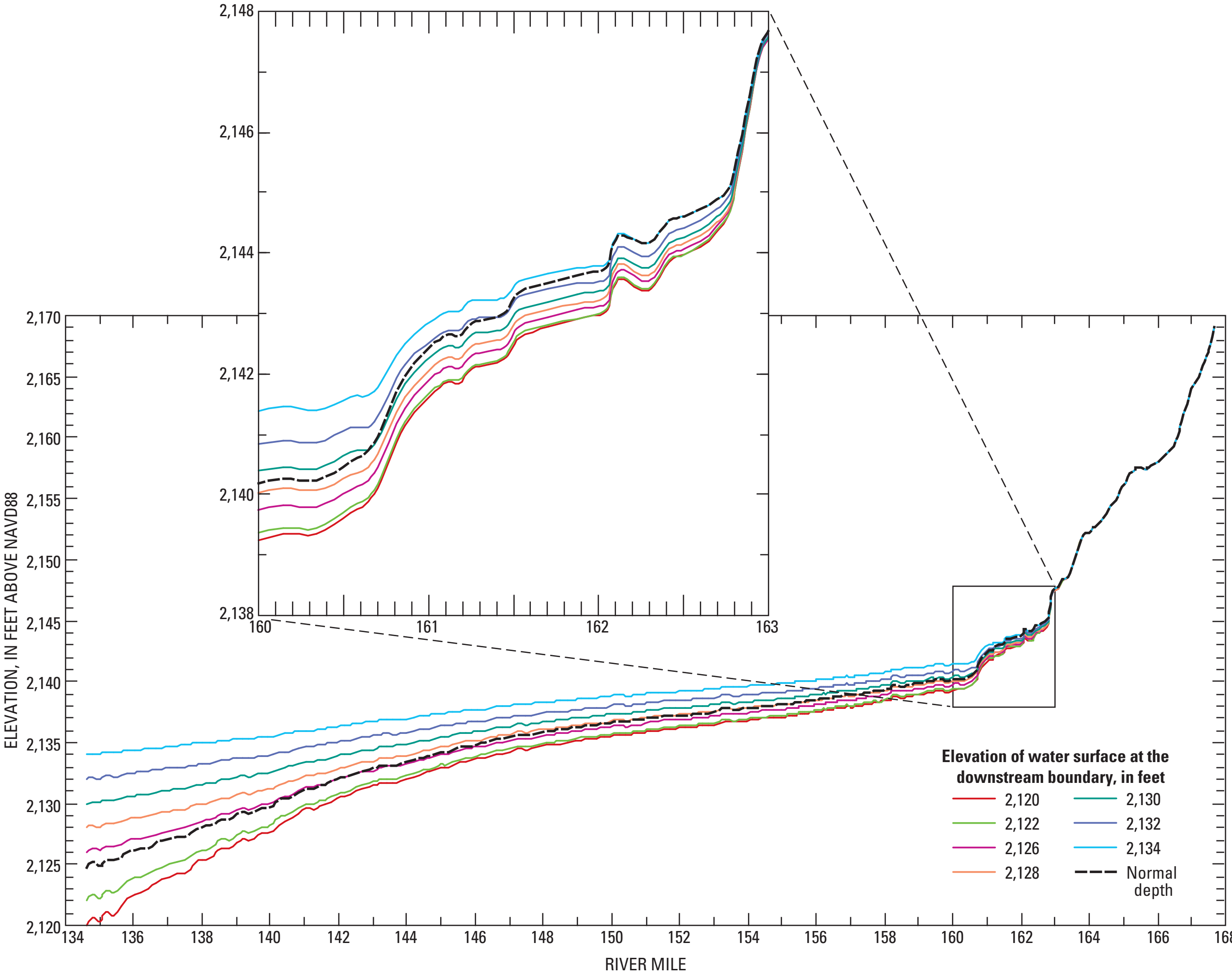


Figure 4. Simulated water-surface curves for a discharge of 25,000 cubic feet per second in the lower Coeur d'Alene River, Idaho.

simulation of 25,000 ft³/s at seven water-surface elevations at the Harrison gaging station (12413860) (RM 134.636). In figure 4, two curves (2,120 and 2,122 ft) are below the normal-depth curve indicating the reach has free-flowing water for the specified discharge and downstream water-surface elevation. Five curves are above the normal-depth curve (backwater condition). The curve for the downstream water-surface elevation of 2,126 ft transitions from backwater conditions to free-flowing conditions near RM 141. Figure 4 inset shows three backwater curves transitioning from backwater conditions to free-flowing conditions between RM 160.5 and 162.5, a 2 mi reach. For example, the 2,132 ft curve (fig. 4 inset) transitions from backwater to free-flowing conditions at RM 161.3, about 0.5 mi downstream of Interstate Highway 90, and the 2,134 ft curve transitions about 700 ft upstream of Highway 90. These transitions occur about 30 mi upstream of the Coeur d'Alene River inlet to the lake.

River Stage

Water-surface elevations at gaging stations were obtained by adding the river stage and datum at each site. For this study, the North American Vertical Datum of 1988 (NAVD 88) datum was used. River stages (or water-surface elevations) have been measured on the Coeur d'Alene River at Harrison since 1991, at Cataldo since 1920, at Enaville since 1940, and at Pinehurst since 1987. River stages at Rose Lake were measured from 1995 through 2000. When cross sections were surveyed during 2004, datums at gaging stations also were surveyed using a Global Positioning System (GPS) allowing conversion of all data to one common datum. This study used the vertical datum of NAVD 88. Table 1 shows datum elevations in National Geodetic Vertical Datum of 1929 (NGVD 29) and NAVD 88 at six gaging stations on the river and lake. Locations of gaging stations are shown in figures 1 and 2. Differences between NAVD 88 and NGVD 29 are not the same everywhere (table 1) because of the Earth's irregular curvature. AVISTA Corporation and others use another vertical datum called "lake datum" in the Coeur d'Alene area. To obtain elevations in NAVD 88, add 0.80 ft to elevations in lake datum.

Since 1903, the Coeur d'Alene Lake gaging station (12415500) has measured stage, which reflects inflow and outflow changes for Coeur d'Alene Lake. Water-surface elevations in the lake show seasonal fluctuations—usually maximum in spring and early summer and minimum in the winter (fig. 5). From the time Post Falls Dam became operational in 1907 until 1941, Avista Corporation (2005) held the summer and autumn lake level at about 2,127.3 ft (2,126.5 ft in lake datum). From 1942 until 2005, the levels were 2,128.8 ft (2,128.0 ft in lake datum). The increase of 1.5 ft since 1942 probably was due to increasing the hydrogeneration at the dam (Hank Nelson, Avista Corporation, oral commun., 2005). The maximum water level for the period of record was 2,139.8 ft on December 25, 1933, and the minimum was 2,120.7 ft on September 12, 1905.

Table 1. Elevation of river and lake stage datums at U.S. Geological Survey gaging stations on the Coeur d'Alene River and Coeur d'Alene Lake, Idaho.

[Locations of gaging stations are shown in figure 1. **Datum elevation**: NGVD 29, National Geodetic Vertical Datum of 1929; NAVD 88, North American Vertical Datum of 1988. **Datum difference:** NAVD 88 minus NGVD 29. **Abbreviation**: ft, foot]

Gaging station No.	River mile	Gaging station name	Datum elevation (ft)		Datum difference (ft)
			NGVD 29	NAVD 88	
12415500	113.1	Coeur d'Alene Lake at Coeur d'Alene	2,100.000	2,100.801	0.801
12413860	134.6	Coeur d'Alene River near Harrison	2,100.000	2,103.639	3.639
12413810	153.4	Coeur d'Alene River at Rose Lake	2,100.000	2,103.831	3.831
12413500	162.9	Coeur d'Alene River at Cataldo	2,100.000	2,103.788	3.788
12413000	168.7	North Fork Coeur d'Alene River at Enaville	2,100.000	2,103.896	3.896
12413470	1.6	South Fork Coeur d'Alene River near Pinehurst	[1]2,190	2,165.448	-24.552

[1]Gage datum was based on 1:24,000 scaled (7.5-minute) quadrangle topographic map.

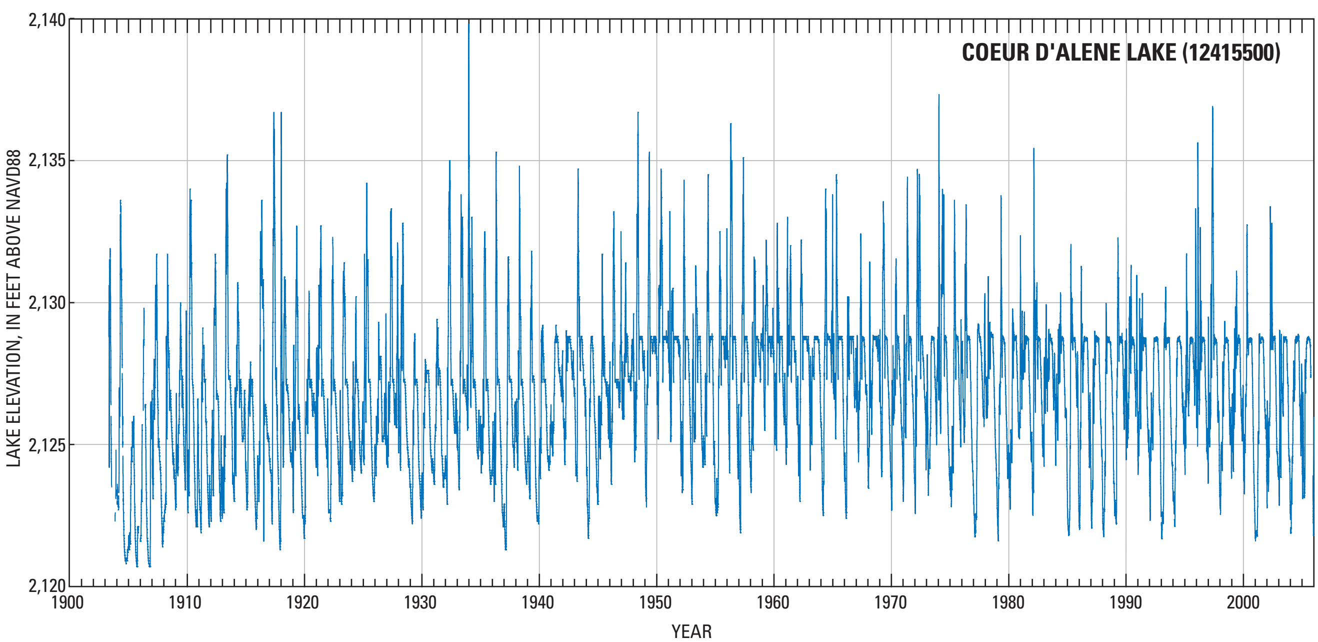


Figure 5. Daily water levels on Coeur d'Alene Lake at Coeur d'Alene (12415500), Idaho. (Location of gaging station is shown in figure 1.)

Water-surface elevations for gaging stations on Coeur d'Alene Lake and River through the backwater reach are similar (fig. 6) but are at different elevations, reflecting the variable water-surface elevation of the backwater curve (M_1) throughout the reach. For example, when elevations in Coeur d'Alene Lake (12415500) increase, water-surface elevations also increase in the river at Harrison (12413860) and Rose Lake (12413810) gaging stations. Water-surface elevations at the Harrison gaging station are almost identical with elevations at the Coeur d'Alene Lake gaging station.

Stage-relations were developed between the Coeur d'Alene Lake gaging station and the Harrison and Rose Lake gaging stations (fig. 7) because stage-discharge relations cannot be developed at the Harrison and Rose Lake gaging stations due to backwater. The curves and equations were derived using simple linear regression methods. These equations relate the water-surface elevation in the lake to water-surface elevations at the respective gaging stations. Figure 7 shows the *r* value (correlation coefficient), *i* value (number of paired data points), and the period of record (POR) value for the paired data. The correlation coefficient is a measure of strength of the linear relation between two variables (Zar, 1998). An *r* value of 0 indicates that no linear association exists between the two variables, whereas, an *r* value of 1 or -1 indicates a strong linear association. The correlation coefficient of water-surface elevations for the lake and Harrison gaging stations was 0.99 (very strong correlation). The correlation of water-surface elevations for the lake and Rose Lake gaging stations was a little weaker ($r = 0.92$) but was still strongly correlated. The *r* value decreased as distance increased from Coeur d'Alene Lake, probably because of the influence of inflows from intervening drainages, influence of inflows and outflows between the lateral lakes and floodplain, and (or) effects of backwater in the river.

The simple linear regression curves in figures 7*A* and 7*B* fit the data reasonably well. The curve shown in figure 7*B* is not accurate when water-surface elevation in the lake is greater than 2,128 ft because the data trend in another direction from the regression curve. The relation in figure 7*B* can be improved by using several linear regressions or non-linear function(s) that describe the entire dataset more accurately.

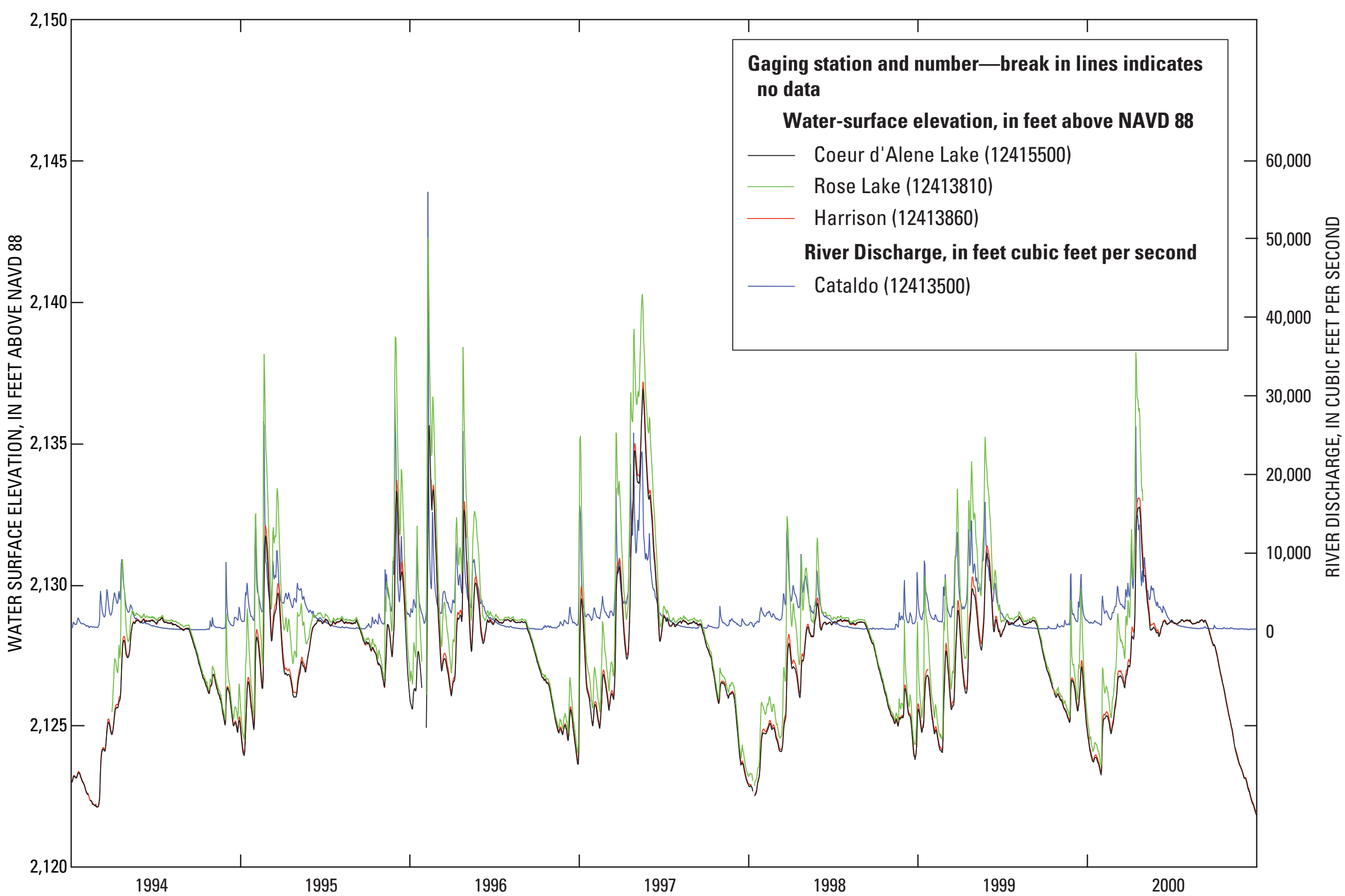


Figure 6. Water-surface elevations and discharge at selected gaging stations on the Coeur d'Alene River and Coeur d'Alene Lake, 1994–2000. (Locations of gaging stations are shown in figure 1.)

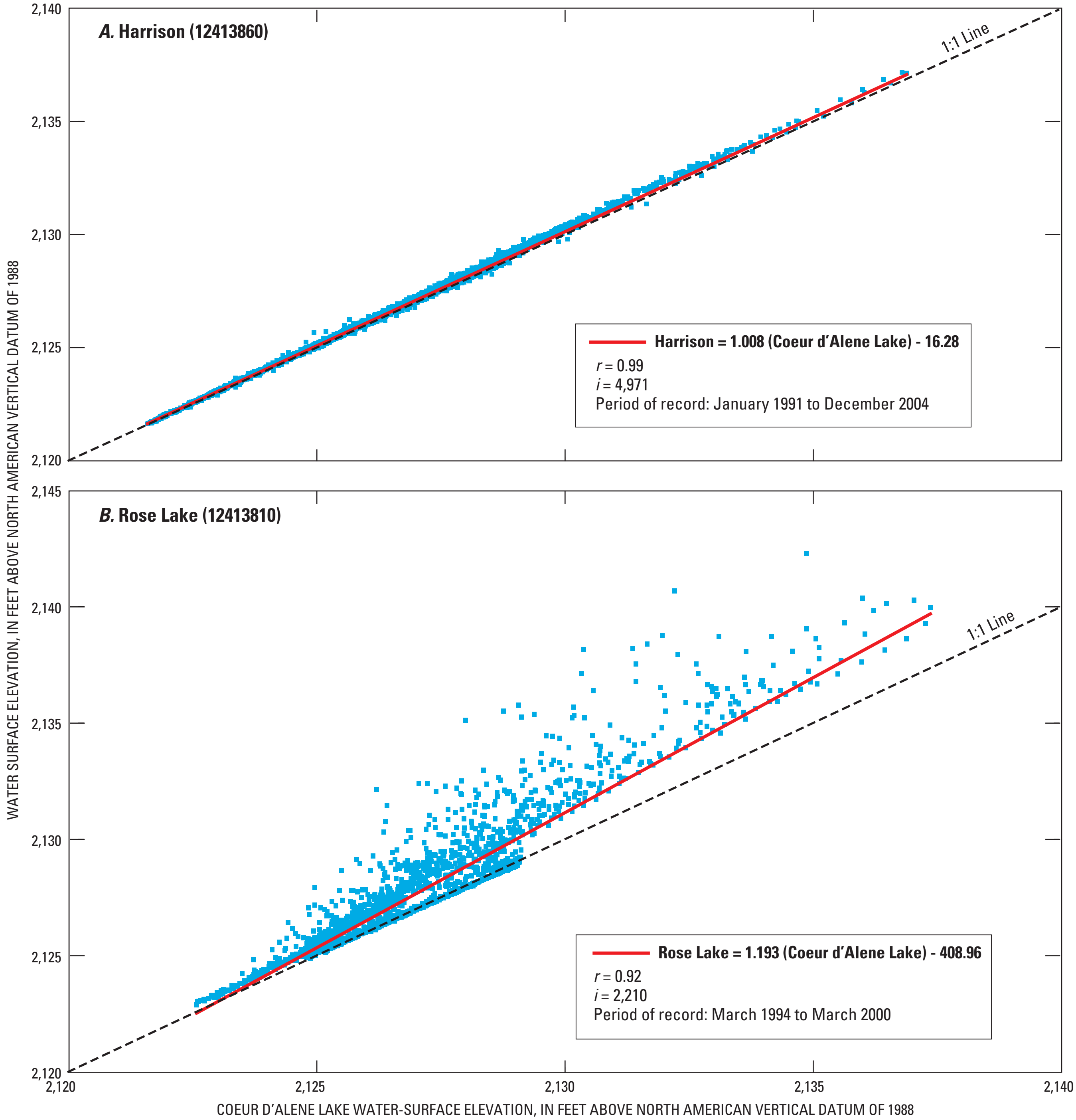


Figure 7. Relation between water-surface elevation for Coeur d'Alene Lake, and the Harrison and Rose Lake gaging stations in the study reach, Coeur d'Alene River, Idaho.

River Discharge

The Coeur d'Alene River has no dam or flood control structures and is subject to seasonal and peak flows. Discharge data have been collected at three gaging stations in the study reach (fig. 8). Continuous data have been collected since 1940 at the Enaville gaging station, 1987 at Pinehurst, and 1912–13 and 1920 at Cataldo except from 1973 to 1986 when the gaging station was not in operation. Figure 8 shows annual and seasonal patterns of discharge. Discharge is highest in winter and spring due to rainstorms and (or) snowmelt runoff and lowest in late summer and autumn when flows rely on base flow conditions. Mean annual discharge at the Cataldo gaging station is about 2,500 ft^3/s. At Enaville, mean annual discharge is about 1,900 ft^3/s, and at Pinehurst, about 510 ft^3/s (Brennan and others, 2006). At Cataldo, average spring runoff is about 15,000 ft^3/s and summer discharges usually are less than 600 ft^3/s (fig. 8). The highest annual mean flow (1974) was about 3,300 ft^3/s and the lowest (1977) was about 600 ft^3/s (Brennan and others, 2006). For the greatest flood of record (January 16, 1974), mean daily discharge and instantaneous peak flow were 50,000 ft^3/s and 79,000 ft^3/s, respectively. For this event, indirect computations were used to estimate the mean daily discharge and instantaneous peak flow because the gaging station was not in operation. The February 9, 1996, flood produced a mean and instantaneous peak flow of 56,000 ft^3/s and 70,000 ft^3/s, respectively (Brennan and others, 2006; updated from Beckwith and Berenbrock, 1996).

Borden and others (2004) noted the volume of discharge passing gaging stations on the NF (Enaville) and SF (Pinehurst) does not sum to discharge at Cataldo ($Q_{Enaville} + Q_{Pinehurst} \neq Q_{Cataldo}$). Usually, the discharge sum from the Enaville and Pinehurst gaging stations was less than at the Cataldo gaging station ($Q_{Enaville} + Q_{Pinehurst} < Q_{Cataldo}$). Borden and others (2004) attributed these differences to additional river discharges from intervening drainages and to streamflow gains and losses from the ground-water system.

Peak flow (flood) estimates for selected recurrence intervals at gaging stations on unregulated and undiverted streams in Idaho were developed by Berenbrock (2002) using peak flow data through 1997. That analysis was statistically based and included the Enaville, Pinehurst, and Cataldo gaging stations. These flood estimates are used for various purposes, such as design of bridges, culverts, and flood-control structures, and the management and regulation of flood plains. For these purposes, peak flow recurrence intervals generally are 50 years or greater. However, there is increasing interest in peak flows (floods) with more frequent recurrence intervals especially for peak flows that mobilize streambed sediments. The peak flow that is probably responsible for creating and (or) maintaining the characteristic size and shape of the channel (channel-forming flow) has been designated as bankfull flow (Leopold and others, 1964; and Knighton, 1998). Without human influences to streams, bankfull flows generally range between the 1.5- and 2.5-year peak flow (flood) (Leopold, 1994). For simplicity, bankfull flow for this study was defined as the 2-year peak flow although actual flows needed to overtop the human affected banks and (or) levees is probably higher.

The 100-year and 2-year peak flow estimates from Berenbrock (2002) were updated for the Enaville, Pinehurst, and Cataldo gaging stations to include an additional 10 years of peak flow data since 1997. The resulting estimates for the 100-year peak flows at Enaville, Pinehurst, and Cataldo gaging stations are 56,200, 14,300, and 69,000 ft^3/s, respectively, and updated estimates of the 2-year peak flow were 15,000, 3,510, and 18,900, respectively. These values were not significantly different (less than 5 percent difference) from Berenbrock (2002) except for the 100-year peak flow at Pinehurst. One reason for the large difference at the Pinehurst gaging station is because 20 peak flow values (1988–2007) were used for this study as compared to 10 values (1988–97) used by Berenbrock (2002). Peak-flow data for the 10 years of record may have been collected during an unusually dry, wet, or otherwise unrepresentative period, and the data may not represent the full range of potential floods at the site; whereas, 20 years of record may be more representative.

Channel Cross Sections

The 1D sediment-transport model (HEC-6) requires accurate representation of the cross-section geometry. A series of cross sections measured at variably-spaced distances along lines oriented perpendicular to the flow direction defined cross-section geometries. Cross sections were surveyed to a common datum. Horizontal control was based on North American Datum of 1983 (NAD 83), Idaho Transverse Mercator Coordinates. Vertical control was based on NAVD 88.

In 2004, USGS personnel surveyed about 60 cross sections on the Coeur d'Alene River between RM 159.8 at Mission Flats to the Enaville (near RM 168.7) and Pinehurst (near RM 1.6) gaging stations. Appendix A shows the locations of cross sections. A GPS and echo sounder were used to obtain bathymetric data, and a GPS was used to obtain bank data along cross sections. The GPS and echo-sounder data were merged into one dataset and edited using HYPACK MAX software by Coastal Oceanographics. Cross sections were located to best represent the hydraulic characteristics of the river. Cross-section spacing ranged from about 800 ft to as much as 3,000 ft. To develop stream channel cross sections, the steps used by Barton and others (2004) were followed; however, a genetic computer program (Berenbrock, 2006)

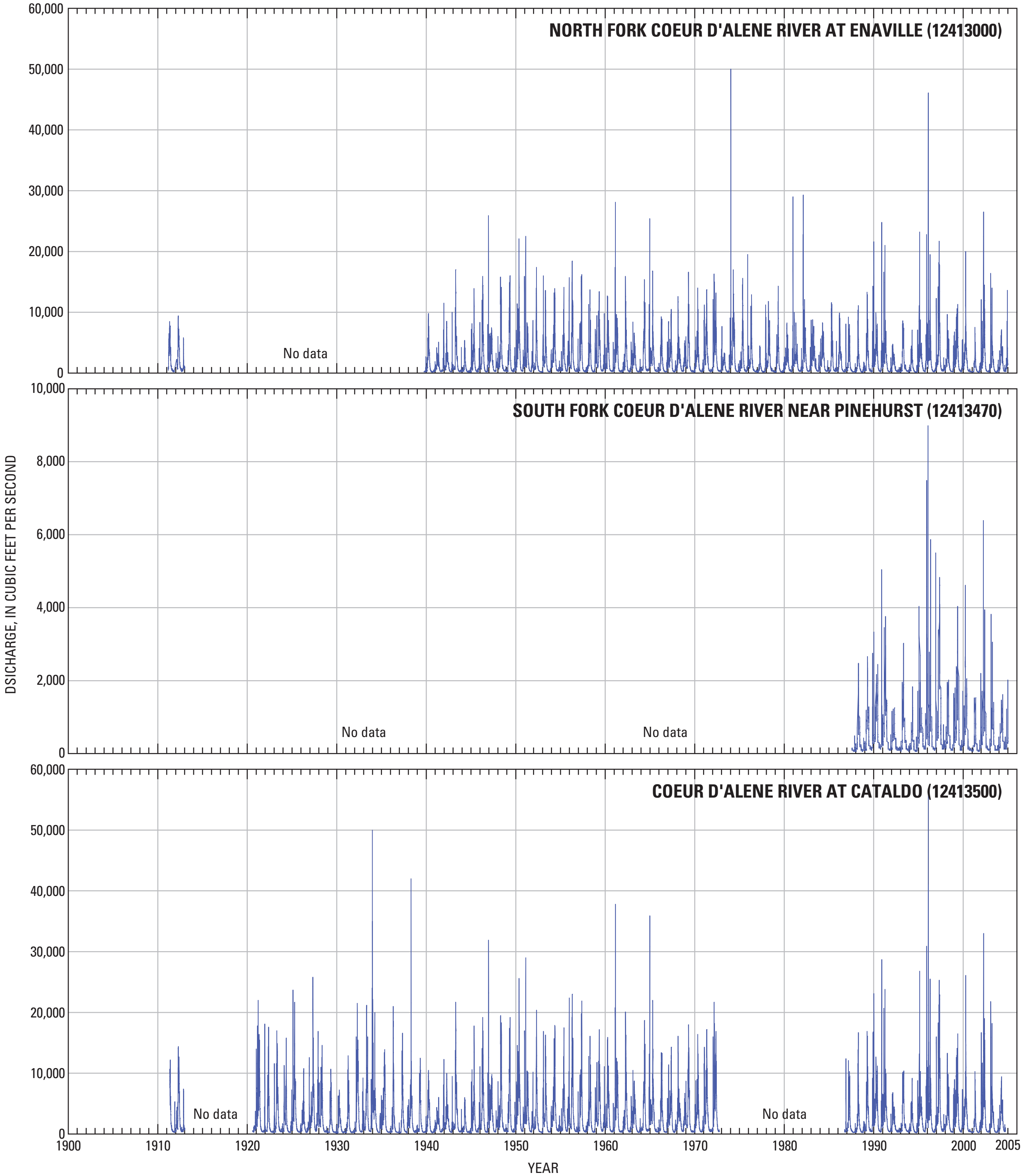


Figure 8. Discharge at selected gaging stations on the Coeur d'Alene River, Idaho. (Locations of gaging stations are shown in figures 1 and 2.)

was used to reduce the number of echo (depth) soundings per cross section from hundreds or several thousands to 80 or fewer. Berenbrock (2006) showed that cross sections produced by the genetic algorithm were representative of the original section and processing time was significantly shorter than using standard procedures. The bathymetry for six cross sections on the SF Coeur d'Alene River was surveyed with a GPS because the river could be waded at these sections during the survey. Also, six cross sections in the braided reach from previous studies were used: four sections from the FourPt model (Woods and Beckwith, 1997) and two sections from the MIKE11 model (Borden and others, 2004). An indirect measurement from the flood of February 9, 1996, was used to develop the upper most cross section on the SF (cross section 1.580).

Several cross sections in the braided reach from the FourPt and MIKE11 models (Woods and Beckwith, 1997; Borden and others, 2004) were compared with surveyed sections from this study to ensure that they were compatible. These comparisons showed that cross-section geometries have changed very little. Figure 9 compares cross sections from the FourPt and MIKE11 models, respectively, with surveyed sections. Because of the similarity, it was acceptable to use cross sections from the previous FourPt and MIKE11 models from the braided reach in this study.

Cross sections in the meander reach (RM 159.8 near Mission Flats to RM 134.6 at the Harrison gaging station) were developed from gridded and LIDAR data. These cross sections (more than 160) are shown on a set of maps in appendix A. The gridded data from Avista Corporation are a composite of bathymetric data and digitized shoreline elevations from aerial photographs obtained at lake elevations of 2,126 and 2,128 ft in lake datum. The bathymetry was surveyed in 2004 using a dual, side-scan sonar. Control was set to the lake datum. LIDAR of the river and floodplain from Highway 95 to the lake were taken on August 31, 2004. Bathymetric data from Avista Corporation were used for the streambed part of the cross section. However, when the cross section extended above an elevation of 2,124 ft on the river banks, LIDAR data were used to avoid inaccuracies in digitizing. The floodplain part of the cross sections was always determined using LIDAR data.

The following steps were used to develop cross sections in the meander reach (see appendix A for locations of cross sections). First, gridded data greater than 2,124 ft were eliminated. Second, the gridded and LIDAR data for each cross section were merged. Third, the data were ordered from left bank (viewed as looking downstream) to right bank, with the left-most data point designated as 0 ft. Distance for all other data points on the cross section extended from the left-most point. Again, cross-section data generally were reduced to 80 or fewer points per cross section using a genetic computer program (Berenbrock, 2006) designed for this purpose.

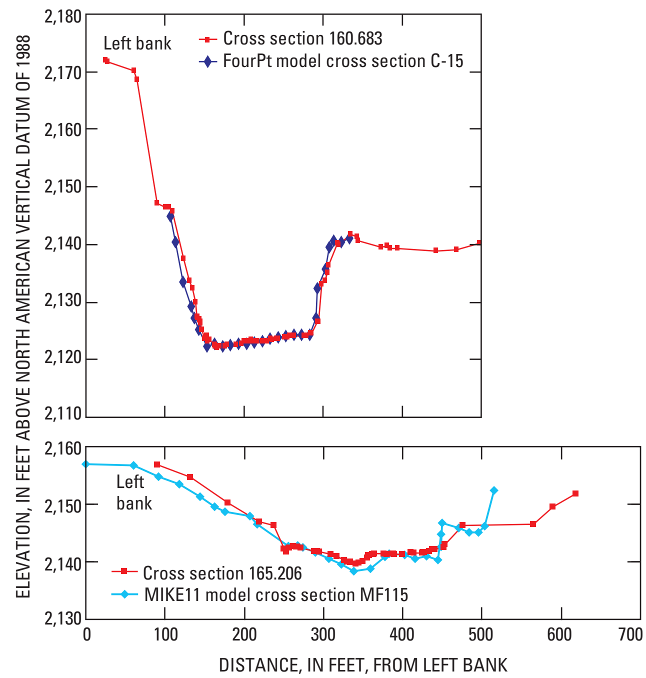


Figure 9. Comparison of selected cross sections in the braided reach on the Coeur d'Alene River, Idaho.

Each cross section was given a station number in river miles corresponding to its location on the river. River miles referenced in this report were derived from designations by the USGS National Mapping Division on 7.5-minute (1:24,000–scale) maps and by the Columbia Basin Inter-Agency Committee (1964). River miles generally are measured in 1-mi increments along the channel centerline in an upstream direction, beginning with 0 at the mouth of the Spokane River at the confluence with the Columbia River at Franklin D. Roosevelt Lake (fig. 1). Since the publication of the referenced documents, the channel length in several places along the Coeur d'Alene River has changed because of bank erosion, deposition, or channel migration. As a result, the actual distances between the river mile designators shown on the maps are not always exactly 1.0 mi. However, because many people are familiar with them and use them for various purposes, continued use is appropriate.

To use these river mile designators for identifying cross sections, the actual distance between river miles was measured from the National Agriculture Imagery Program (NAIP) digital orthophotos taken in 2004. Distance between the nearest downstream river mile designator to the cross section was measured along the channel's centerline of the digital orthophoto. The ratio of cross-section distance to distance between river miles was calculated and used as the extension in the cross-section name. For example, cross section RM 156.667 is two-thirds of the way between RM 156 and 157.

Channel cross sections differ between the braided and meandering reaches. Cross sections in the braided reach have widths greater than 500 ft, depths usually less than 15 ft, and average depths less than 10 ft. At low flows, exposed islands and (or) bars at these cross sections divide the river into separate channels. High flows often submerge many of the islands and (or) bars. However, a few permanent islands are in this reach near RM 162.5 and RM 167. From RM 165.7 to 166.8 near Kingston, the channel splits into two branches with the main channel located in the left branch. Channel slope in the braided reach is about 6.5×10^{-4} ft/ft. Cross sections in the meander reach are about 300- to 400-ft wide with depths greater than 20 ft. Depths greater than 40 ft occur in and around channel bends. Channel slope in the meander reach is about 6.5×10^{-5} ft/ft, 10 times less than the slope in the braided reach.

Streambed Samples

Information on particle-size distribution came from streambed material samples collected by previous investigators (URS Greiner, Inc., and CH2M-Hill, 2001; Borden and others, 2004) and this study. In 1997, four sites were sampled to characterize the streambed sediments in the meander reach of the Coeur d'Alene River (URS Greiner, Inc., and CH2M-Hill, 2001). Streambed sediment samples were collected near the left bank (LB), left of middle of channel (LMID), right of middle of channel (RMID), and near the right bank (RB). These samples were collected using a drill core and sent to a laboratory for particle-size analysis. The d_{50} of these samples shown in table 2 ranged from 0.016 mm at RM 132.1 near Harrison to 0.34 mm at RM 159.6 near Mission Flats. They are classified as medium silt and medium sand, respectively. The d_{50} decreased downstream. These samples showed no significant variation in d_{50} across the channel.

Table 2. Median diameter and particle-size classification of streambed samples, Coeur d'Alene River, Idaho.

[**Particle size classification** shown in table 3. **Location of sample in channel:** LB, sample collected near left bank; LMID, sample collected left of center of channel; RMID, sample collected right of center of channel; MID, sample collected near center of channel RB, sample collected near right bank. **Abbreviations**: d_{50}, median diameter of streambed samples; mm, millimeter; –, unknown]

Site	River mile	Sample date	Sample depth (ft)	d_{50} (mm)	Particle size classification	Location of sample in channel	Sampler
			Braided reach				
PC-NFCDA	168.1	8-20-01	0	53.7	Very coarse gravel	–	University of Idaho[1]
SF-CDA	.3	8-21-01	0	18.8	Coarse gravel	–	University of Idaho[1]
CDA-PC2	167.0	8-22-01	0	41.7	Very coarse gravel	–	University of Idaho[1]
CDA-PC4	166.3	8-23-01	0	37.4	Very coarse gravel	–	University of Idaho[1]
CDA-PC6	164.8	8-24-01	0	22.8	Coarse gravel	–	University of Idaho[1]
			Meander reach				
97CAT01	159.6	10-07-97	0–2.2	0.34	Medium sand	LB	URS Greiner[2]
97CAT02	159.6	12-07-97	0–2.8	.21	Fine sand	LMID	URS Greiner[2]
97CAT03	159.6	12-08-97	0–2.4	.18	Fine sand	RMID	URS Greiner[2]
97CAT04	159.6	12-08-97	0–2.0	.19	Fine sand	RB	URS Greiner[2]
97MED01	144.7	12-11-97	0–2.7	.12	Very fine sand	LB	URS Greiner[2]
97MED02	144.7	12-10-97	0–2.8	.1	Very fine sand	LMID	URS Greiner[2]
97MED03	144.7	12-10-97	0–2.6	.14	Very fine sand	RMID	URS Greiner[2]
97MED04	144.7	12-11-97	0–1.9	.11	Very fine sand	RB	URS Greiner[2]
97SWN01	139.5	12-12-97	0–3.0	.038	Course silt	LB	URS Greiner[2]
97SWN02	139.5	12-12-97	0–4.7	.094	Very fine sand	LMID	URS Greiner[2]
97SWN03	139.5	12-12-97	0–1.9	.054	Course silt	RMID	URS Greiner[2]
97SWN04	139.5	12-13-97	0–2.7	.14	Fine sand	RB	URS Greiner[2]
97HAR01	132.1	12-14-97	0–5.4	.025	Medium silt	LB	URS Greiner[2]
97HAR02	132.1	12-14-97	0–3.3	.029	Medium silt	LMID	URS Greiner[2]
97HAR03	132.1	12-14-97	0–2.3	.016	Medium silt	RMID	URS Greiner[2]
97HAR04	132.1	12-19-97	0–3.9	.069	Very fine sand	RB	URS Greiner[2]
			Dudley reach (within meander reach)				
D1	157.067	05-04-05	0	0.41	Medium sand	MID	U.S. Geological Survey
D2	156.686	05-05-05	0	.59	Coarse sand	MID	U.S. Geological Survey
D3	156.213	05-06-05	0	.37	Medium sand	MID	U.S. Geological Survey
D4	155.739	05-07-05	0	.31	Medium sand	MID	U.S. Geological Survey

[1]Borden and others (2004).

[2]URS Greiner, Inc., and CH2M-Hill (2001), table A-5.

In 2001, the University of Idaho (Borden and others, 2004) sampled five sites in the braided reach. Wolman (1954) described the sampling method used to determine the size distribution of sediments along the surface of the streambed. Samples included only particles larger than 4 mm (Borden and others, 2004) from the armored surface layer, the topmost layer. A ½ phi (ϕ) gravelometer, that measures the intermediate axis of a particle, was used to sample the armored-surface layer. Armoring is not present in sandbed dominated reaches, (for example, the meandering reach). Sediments in an armored surface layer commonly are larger than the underlying channel fill. These sediments tend to armor or protect the streambed from erosion under low- to moderate-flow conditions. The d_{50} of bed material below the armored layer ranged from 18.8 to 53.7 mm (table 2), and d_{50} decreased downstream. These samples were classified as coarse gravel to very coarse gravel (table 3). Particle-count analysis from Borden and others (2004) indicated the largest particle on the surface layer was 128 mm—the approximate thickness of the armored-surface layer. A particle of this size is considered coarse cobble (table 3). The smallest d_{50} was in the SF probably because of the additional sediment contribution or loading of fine sediments from mine tailings.

In 2005, four additional samples were collected to better define the streambed in the Dudley reach for use in a 1D sediment-transport model (HEC-6) and a 2D hydraulic and bed-shear stress model. These samples were collected using a ponar dredge sampler near the center of the channel. Particle-size analysis was conducted on these samples using the equipment and facilities at the Department of Engineering Laboratory, Boise State University. The methods and procedures used for the particle-size analyses are outlined in the American Society for Testing and Materials' Manual on Test Sieving Methods (1985), the USGS Vancouver Sediment Laboratory's Quality Control and Quality Assurance Plan (Daniel J. Gooding, U.S. Geological Survey, written commun., 2000), and the American Society of Civil Engineers' Manual on Sedimentation (1975). These samples were analyzed using the dry-sieve method described in the references above to determine the percent-finer-than and the cumulative percent-finer-than fractions, and the particle-size characteristics.

Table 2 shows the d_{50} and particle-size and classification of the four Dudley reach samples. The cumulative percent-finer-than fractions and other particle-size characteristics are provided in appendix B. The d_{50} ranged from 0.31 to 0.59 mm (table 2) and was classified as medium to coarse sand, respectively. The d_{50} decreased downstream. In sample D1 (cross section 157.067), three large particles with diameters (measure of intermediate axis) larger than 5 mm (fine gravel) were interspersed in a matrix of moderately-sorted sand (appendix B). This sample also included particles ranging from 2 to 4 mm (very fine gravels). Therefore, the d_{50} classification of this sample was medium sand. One particle with an intermediate axis of about 8 mm (medium gravel) was collected in sample D2 (at cross section 156.686. This sample (classified as coarse sand) primarily consisted of poorly sorted sands and gravels and included the widest particle-size distribution of the dredge samples. Samples D3 and D4 were classified as medium sand.

Table 3. Particle-size classification.

[Particle-size classification modified from Buffington and Montgomery (1999) and Folk (1980). **Symbol:** ϕ, phi scale where ϕ = -$\log_2$ (diameter in mm); **Abbreviation:** mm, millimeter]

Diameter of particle		Classification name
ϕ	mm	
-8	256	
		Coarse cobble
-7	128	
		Fine cobble
-6	64	
		Very coarse gravel
-5	32	
		Coarse gravel
-4	16	
		Medium gravel
-3	8	
		Fine gravel
-2	4	
		Very fine gravel
-1	2	
		Very coarse sand
0	1	
		Coarse sand
1	.5	
		Medium sand
2	.25	
		Fine sand
3	.125	
		Very fine sand
4	.0625	
		Coarse silt
5	.0310	
		Medium silt
6	.0165	
		Fine silt
7	.0076	

Sediment-Transport Characteristics

Sediment-transport models also require data on the variation of total sediment discharge (suspended-sediment discharge [fine and sand] plus bedload) with changes in stream discharge at the upstream model boundary. Measurements of suspended-sediment discharge also are required to test model performance.

The available supply of fine-grained particles typically controls the suspended-sediment discharge of fine-grained particles in a stream because the supply often is less than the stream can transport (Colby, 1956). These fine-grained sediments move downstream at about the same velocity as the water.

In contrast, the supply of coarser grained sediments in streams generally is greater than the stream can transport; therefore the transport of coarser grained sediments as bedload typically is controlled by the ability of the stream to transport them (Guy, 1970). Bedload is sediment that moves on or near the streambed by sliding, rolling, or bouncing (Edwards and Glysson, 1999). Most bed sediment moves occasionally, but remains at rest much of the time, especially in gravel/cobble/boulder streams. Because of these differences in transport mechanisms, large variations can be expected in the concentrations and grain-size characteristics of sediments at different locations in a stream and with changes in stream discharge. Fine- and coarse-grained sediment concentrations in a stream increase with increasing stream discharge (Edwards and Glysson, 1999).

Suspended Sediment

Since the study of Clark and Woods (2001) ended in April 2000, additional suspended-sediment samples have been collected at three sites in the study reach: NF Coeur d'Alene River at Enaville (12413000), SF Coeur d'Alene River near Pinehurst (12413470), and Coeur d'Alene River near Harrison (12413860). The first two sites are at the upstream boundary of the study area, and the last site (Harrison) is at the downstream boundary. Clark and Woods (2001) collected samples only at the Rose Lake gaging station (12413810) and provide a complete description on the collection, quality control, and processing of suspended sediments.

Clark and Woods (2001) developed relations between suspended sediment and river discharge from data collected between February 1999 and April 2000. They used a power function to develop transport curves for sediment discharge. First they converted suspended-sediment data from milligrams per liter to tons per day using $Qs = Q \times Cs \times k$, where Qs is suspended-sediment discharge, in tons per day; Q is stream discharge, in cubic feet per second; Cs is suspended-sediment concentration, in milligrams per liter; and k is a conversion factor of 0.0027. A relation between Qs and Cs then was developed for each gaging station. The data pairs for the Enaville and Pinehurst gaging stations (Clark and Woods, 2001) showed a strong correlation ($r = 0.974$ and $r = 0.945$, respectively); however, the Rose Lake and Harrison gaging stations showed a weaker correlation ($r = 0.888$ and $r = 0.829$, respectively). The r value increased as distance increased from Coeur d'Alene Lake probably due to the effects of backwater in the river.

The relations between suspended sediment and river discharge were then updated using the same procedures as Clark and Woods (2001). The old and new regression curves and new equations and correlation coefficients for the Enaville, Pinehurst, and Harrison gaging stations for suspended sand discharges are shown in figure 10.

The old and new regression curves and new equations for suspended fines (silt and clay) discharges, and the sampled data pairs are shown with the relations in figure 11. No updated curve was available for the Rose Lake gaging station because no suspended-sediment samples were collected since Clark and Woods' (2001) study. The data pairs for these sites had a strong correlation ($r \geq 0.90$). The highest r value of 0.964 occurred at the Enaville gaging station for suspended sand discharge, and the lowest r value of 0.906 occurred at the Harrison gaging station for suspended fine discharge. For these sites, the scatter amount about the regression line is minimal. However, for the Pinehurst gaging station, a fair amount of scatter is around the regression line in suspended fine (silt and clay) and sand discharges. Clark and Woods (2001) attributed the scatter to hysteresis.

Total Sediment Discharge

Suspended-sediment discharge (fines and sands) plus bedload data were used to determine total sediment discharge. Bedload samples were collected during Clark and Woods' (2001) study, and since then, no bedload samples have been collected. The bedload curves from Clark and Woods' (2001) were used without modification. Total sediment discharge (Q_T) and total suspended-sediment discharge curves for the Enaville, Pinehurst, Rose Lake, and Harrison gaging stations are shown in figure 12. The bedload contribution to total sediment discharge is small; typically less than 15 percent (Knighton, 1998). Emmett (1975) indicated that bedload contribution ranged from 1 to 10 percent for streams in the upper Salmon River basin. Clark and Woods (2001) indicated the contribution from bedload from Enaville and Pinehurst gaging stations was less than 10 percent. For the Rose Lake and Harrison gaging stations, the bedload contribution was less than 1 percent. Although bedload was sampled several times at the Harrison gaging station, no sediments were collected in the samplers even at a discharge of 24,500 ft^3/s (April 16, 2002). Thus, an assumption of zero bedload was made at the Harrison gaging station. Total sediment discharges (Q_T) for the Enaville and Pinehurst gaging stations were used to estimate the total sediment-transport discharge for any river discharge at the upstream boundary of the sediment-transport model. Sediment discharge at the Harrison gaging station was used to test the sediment-transport model.

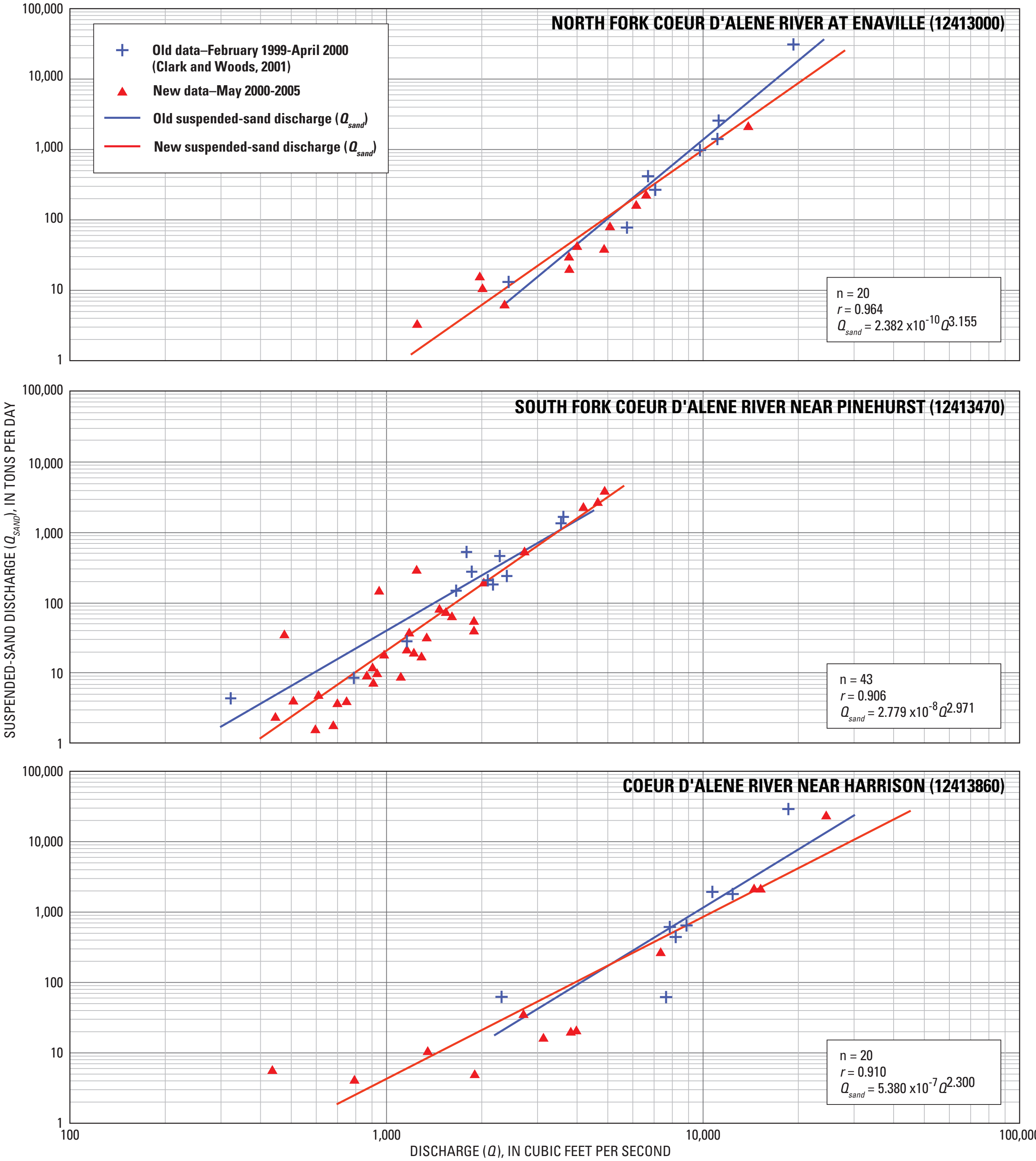


Figure 10. Sediment-transport curves for suspended sand discharges at selected sites in the study area, Coeur d'Alene River, Idaho.

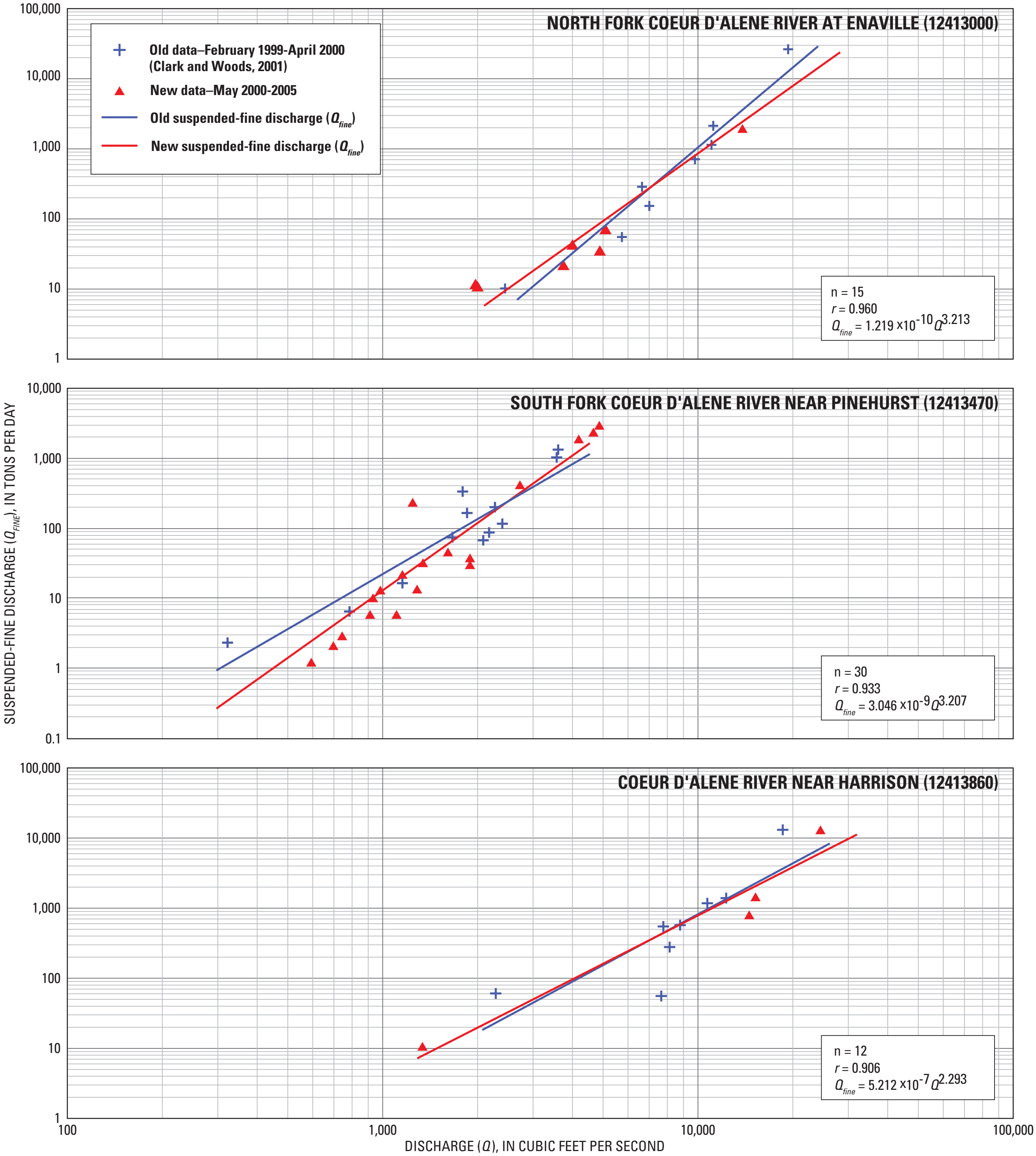


Figure 11. Sediment-transport curves for suspended silt and clay (fines) discharges at selected sites in the study area, Coeur d'Alene River, Idaho.

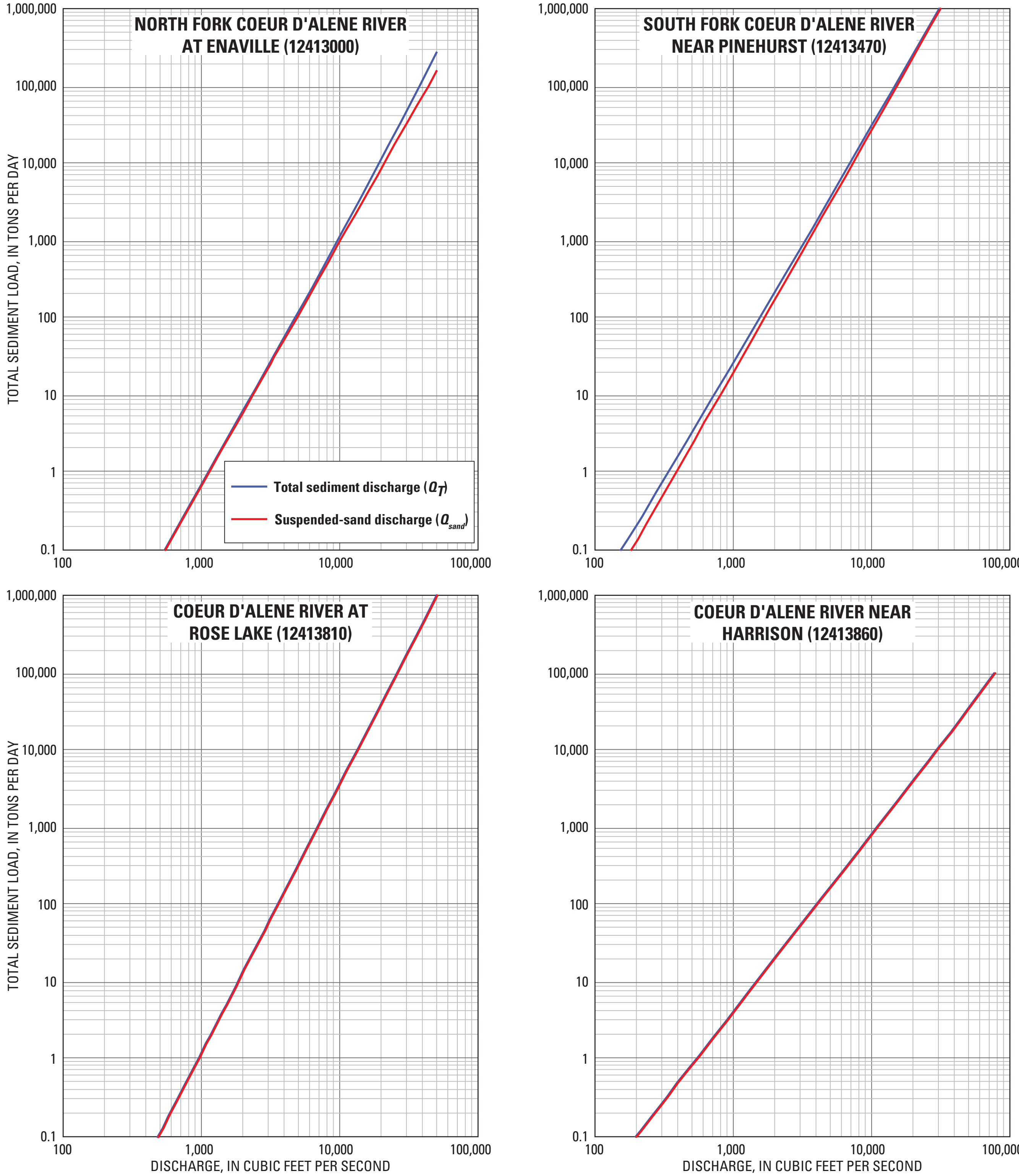


Figure 12. Total sediment discharge (Q_T) and suspended-sand discharge (Q_{sand}) curves at selected sites in the study area, Coeur d'Alene River, Idaho.

Comparison of total sediment discharges (Q_T) from the Enaville and Pinehurst gaging stations indicates that on an equal discharge basis, the contribution of total sediment discharge (Q_T) is greater from the South Fork than from the North Fork. Total sediment discharge of the South Fork near Pinehurst is about 10 times greater than from the North Fork at Enaville for river discharges ranging from 100 to 10,000 ft^3/s. For river discharges ranging from 1,000 to 5,000 ft^3/s, total sediment discharge on the South Fork near Pinehurst is about 15 times greater than the North Fork at Enaville. Because water discharge is much greater from the North Fork than the South Fork, the annual contribution of sediment discharge to the main stem is greater from the North Fork than the South Fork. For example, in water year (WY) 1996, Q_T for the North Fork at Enaville was 381,000 ton/d and for the South Fork near Pinehurst was 73,400 ton/d, about one-fifth of Enaville. On average in WY 1996, river discharge at the Enaville gaging station was four times greater than the river discharge of Pinehurst.

Numerical Modeling

The primary objective of numerical modeling was to simulate the effects of changing river discharges and lake stages in the Dudley reach on velocities, bed shear stress, erosion and deposition, and sediment mobility. Successful models can be used to estimate water-surface elevations, flow depths, velocities, shear stresses, erosion, deposition, and sediment transport for flows of varying magnitudes and stages.

HEC-6 Model Implementation

The HEC-6 computer model, version 4.2, (U.S. Army Corps of Engineers, 1993) was used to construct a sediment-transport model of the Coeur d'Alene River. Sediment-transport processes were not simulated in most previous modeling studies of this reach, and the streambed was assumed to be stable (fixed bed). However, in this study, sediment-transport processes were simulated because the model was developed to include a movable streambed. The modeled reach extended from Enaville on the NF to Springston, about 1.5 mi upstream of the Coeur d'Alene River inlet to the lake—an actual flow distance of 35.0 mi. The actual flow distance on the SF is 1.6 mi; therefore, the total model length is 36.6 mi.

HEC-6 is a computer program that analyzes 1D, gradually varied, steady flow in open channels with movable boundaries due to scour and deposition (U.S. Army Corps of Engineers, 1993). In areas where flow velocity is changing rapidly, the gradually varied flow assumption requires the use of closely-spaced cross sections. The HEC-6 model uses the standard step method (Chow, 1959) to determine changes in water-surface elevations from one cross section to the next by balancing total energy head at the sections. This 1D model assumes that energy is uniform in a cross section. This assumption is only valid at locations where flow is parallel to the main channel or where vertical velocities are not significant. The simulated channel does not account for debris because the model assumes unobstructed flow. Also HEC-6 cannot simulate flows through bridges or culverts because the program does not include equations to simulate these features.

HEC-6 allows for simultaneous erosion and deposition to occur depending on the competency of the stream to transport suspended sediment and bedload. However, HEC-6 does not allow bank erosion or lateral channel migration. This model can simulate the transport of sediment from upstream sources, transport of bed and suspended loads, and the effects of an armored surface layer on flow. The model can simulate transport of sediment sizes as large as 2,048 mm and includes 11 predefined sediment transport equations. The model also can simulate the transport of silt and clay. The model first calculates the water-surface elevation at each cross section using the standard step method. The potential sediment transport rate at each cross section, combined with the flow, determines the suspended sediment volume in each reach. If this volume exceeds the transport capacity of the reach, deposition occurs in the reach. If the volume is less than the transport capacity of the reach, scouring occurs. After each time step, the model updates the channel geometry in each section of the reach to account for the effects of scour and deposition. Finally, the flow value from the next time step is read and a new water-surface elevation is calculated using the updated channel geometries. This procedure is repeated until the model completes all specified time steps. The number of time steps is based on trial-and-error simulations to determine when changes in streambed elevations are minimal between one time step and the next. Sediment-transport calculations are performed by grain-size class, allowing the model to simulate hydraulic sorting and to control the rate of erosion and redeposition of sediment during the simulation period.

The HEC-6 model requires the user to select a sediment-transport equation. Eleven transport functions are available in the HEC-6 model. These equations were developed under different flow, hydraulic, and sediment conditions. Some of these equations are used for sandbed streams, gravelbed streams, or both; small streams, large streams, or both; and some are used to simulate bedload, suspended load, or both (total load). Stream-discharge equations based on stream-power concepts are more accurate than those based on other concepts, such as the shear-stress approach of Kalinske (1947) and Meyer-Peter and Müller (1948), the probabilistic approach of Einstein (1950), and the regression-equation approach of Rottner (1959), as described in Yang and Huang (2001) and Gomez and Church (1989). The Coeur d'Alene

River study reach, required a sediment-discharge equation capable of computing the total load, consisting of sediment particles ranging in size from very-fine sands to cobbles. The Ackers and White (1973) equation fulfilled the transport equation requirement for the HEC-6 simulations. In a paper about accuracies of transport equations, Yang and Huang (2001) indicated the Ackers and White (1973) equation was accurate for a wide range of stream power and sediments sizes. Muskatirovic (2005) also showed that the Ackers and White (1973) equation fit measured data more closely than other equations for streams in the Salmon River Basin. This leads to the conclusion that use of a stream power type equation is a reasonable approach.

Model input consists of data describing cross sections, incoming sediment transport loads, distribution of streambed sediments, boundary conditions (discharge and stage), and time steps. The HEC-6 User's Manual (U.S. Army Corps of Engineers, 1993) provides complete explanations of model input and shows examples of model inputs. An example of HEC-6 model input for calendar year 1999 is presented in appendix C.

Model Cross Sections

The 234 cross sections used in the model included 62 that were surveyed in the field, 161 that were quantified using bathymetry and LIDAR data, and 11 that were interpolated from two adjacent surveyed sections. A series of maps in appendix A show the locations of cross sections. The field-surveyed cross sections are located in the braided reach, and cross-section data were collected using GPS and echo-sounder equipment, electronic total station, and (or) transit. Of the field-surveyed cross sections, four were used from the FourPt model (Woods and Beckwith, 1997) (cross sections 160.859, 161.705, 161.873, and 162.081) and three from the MIKE11 model (Borden and others, 2004) (cross sections 164.137, 167.004, and 167.676). The 161 cross sections developed from bathymetry and LIDAR data are located in the meander reach.

Seven bridges cross the river in the study reach—five roadway-highway and two bike trail. Three of the bridges (Highway 3 bridge near River Mile 150, Highway I-90 bridge, and old Highway I-90 bridge) have piers in the river. The ratio of bridge-pier area to flow area for these bridges was less than 5 percent; thus, the piers probably do not significantly constrict the river's discharge through the bridge. HEC-6 does not allow for the simulation of bridges because the program does not include equations to simulate these features. Discharge measurements around these bridges during high flows would help determine if the configuration of these bridges and piers effect flow. However, cross sections at or near the bridges were used in the model.

Eleven interpolated cross sections (162.506, 162.599, 162.692, 162.948, 165.685, 165.719, 166.157, 166.255, 166.353, 166.543, and 166.636) were generated at various locations along the braided reach by interpolating data from two adjacent cross sections to minimize flow conveyance changes between the surveyed cross sections, thus, maintaining computational stability. For example, cross section 166.543 was interpolated from upstream cross section 166.729 and downstream cross section 166.451. Interpolation was computed by weighting the data from the two cross sections by the distance from the interpolated cross section. Interpolated cross section 166.543 was one-third of the distance from downstream section 166.451 and two-thirds of the distance from upstream section 166.729. This interpolation was done using a feature in the HEC-RAS model (Brunner, 2002a, 2002b; Warner and others, 2002). Interpolated cross sections improve model convergence and the solution used to determine the water surface.

The model used actual flow distances between cross sections, not the distance from subtracting river-mile designators for cross sections. Average difference in the study reach between actual flow and river-mile designator distances is about 35 ft. Using actual flow distances gives a better estimate of friction losses than using the more arbitrary river-mile designator distances. For example, the actual flow distance between cross sections 136.025 and 136.226 is 1,338.9 ft. Based on river-mile designators, the distance is 1,061.3 ft, a difference of 277.6 ft.

Model Boundaries

Flow in the study reach is subcritical. Therefore, the model requires discharge data at the upstream boundaries (cross section 168.713 on the NF and cross section 1.580 on the SF), and water-surface elevation at the downstream boundary (cross section 134.636). Discharge at the upstream boundary on the NF (cross section 168.713) was based on discharge data from the Enaville gaging stations (12413000). Discharge at the upstream boundary on the SF (cross section 1.580) was based on discharge data from the Pinehurst gaging station (12413470). Also discharge was added to cross section 166.729 near Kingston to account for additional discharge from intervening drainages and ground-water gains and losses between the NF and SF and the Cataldo gaging stations. Water-surface elevation at the downstream boundary (cross section 134.636) was based on adding stage data from the Harrison gaging station (12413860) and the NAVD 88 datum.

Model Calibration

Calibration is the process of adjusting model parameters within reasonable limits to obtain the best fit of model simulation results to measured data. The process is to repeatedly adjust a parameter, run the model, and inspect the differences between model simulation results and measured data with the objective of minimizing the differences.

For this model, calibration consisted of comparing the difference between simulated and measured water-surface elevations at Rose Lake (12413810), Cataldo (12413500), Enaville (12413000), and Pinehurst (12413470) gaging stations (fig. 2). Four historical stage-discharge conditions in 1996 and 1997 were identified where discharge and water-surface elevation remained steady through the study reach at least for several days. During this period, high river discharges occurred and the Rose Lake gaging station was operational. Discharge on the main stem of the Coeur d'Alene River was based on daily mean discharge from the Cataldo gaging station. On the main stem just downstream of the confluence of the NF and SF at cross section 167.676, discharges from both river forks were added. Also on the main stem, discharge was added or subtracted to cross section 166.729 near Kingston to account for differences in discharge between the NF plus SF and the Cataldo gaging station. Discharges for the NF and SF were based on the Enaville and Pinehurst gaging stations, respectively, for the same period as the Cataldo gaging station. Water-surface elevations at gaging stations were calculated by adding the daily mean stage to the NAVD 88 datum and were calculated for the same period as discharges. In the model, Manning's *n* values (roughness coefficient) were used as a calibration parameter. Model calibration was considered acceptable when the difference between simulated and measured water-surface elevations for each calibration condition was within ±0.15 ft.

Results from the water-surface elevation calibrations are shown in table 4. Differences in water-surface elevations ranged from -0.11 to 0.09 ft. Only Manning's *n* values of the streambed were adjusted during this process because no field-determined *n* values were available. Adjustments were made equally to cross sections in each reach. Six reaches were defined, with the longest consisting of the entire meander reach (RM 134.6 to RM 159.8). The NF and SF also were defined as one reach. Figure 13 shows the final *n* values for the four reaches on the main stem. The *n* values for the NF ranged from 0.034 to 0.050, and SF ranged from 0.025 to 0.041. The *n* values in all six reaches decreased as discharges increased. No adjustments were made to the *n* values for the banks, which ranged from 0.029 in the meander reach to 0.045 in the NF and SF.

Table 4. Measured and HEC-6 simulated water-surface elevations and differences in four model calibrations for five gaging stations in the modeled reach, Coeur d'Alene River, Idaho.

[**Abbreviations:** WSE, water-surface elevation; ft^3/s, cubic foot per second; ft, foot; XS, cross section; NA, not applicable]

Model calibration No.	Date	Category	Gaging stations				
			Harrison (12413860) [XS 134.636]	Rose Lake (12413810) [XS 153.362]	Cataldo (12413500) [XS 162.948]	Enaville (12413000) [XS 168.713]	Pinehurst (12413470) [XS 1.580]
1	02-10-96	Main-stem discharge (ft^3/s)	41,000	41,000	41,000	29,500	5,500
		Measured WSE (ft)	2,132.34	2,142.28	2,150.79	2,176.36	2,178.49
		Simulated WSE (ft)	[1]2,132.34	2,142.22	2,150.73	2,176.46	2,178.48
		WSE difference (ft)	NA	.06	0.06	-.10	.01
2	04-25-96	Main-stem discharge (ft^3/s)	25,500	25,500	25,500	19,400	3,850
		Measured WSE (ft)	2,129.95	2,138.40	2,147.44	2,173.69	2,176.76
		Simulated WSE (ft)	[1]2,129.95	2,138.46	2,147.41	2,173.76	2,176.87
		WSE difference (ft)	NA	-.06	.03	-.07	-.11
3	05-24-96	Main-stem discharge (ft^3/s)	6,440	6,440	6,440	4,130	1,300
		Measured WSE (ft)	2,130.20	2,132.03	2,141.90	2,166.82	2,175.06
		Simulated WSE (ft)	[1]2,130.20	2,132.02	2,141.91	2,166.76	2,175.00
		WSE difference (ft)	NA	0.01	-.01	.06	.06
4	05-17-97	Main-stem discharge (ft^3/s)	22,200	22,200	22,200	16,700	4,610
		Measured WSE (ft)	2,136.70	2,140.27	2,147.05	2,172.69	2,178.33
		Simulated WSE (ft)	[1]2,136.70	2,140.24	2,147.03	2,172.60	2,178.36
		WSE difference (ft)	NA	.03	.02	.09	-.03

[1] Water-surface elevation for downstream model boundary.

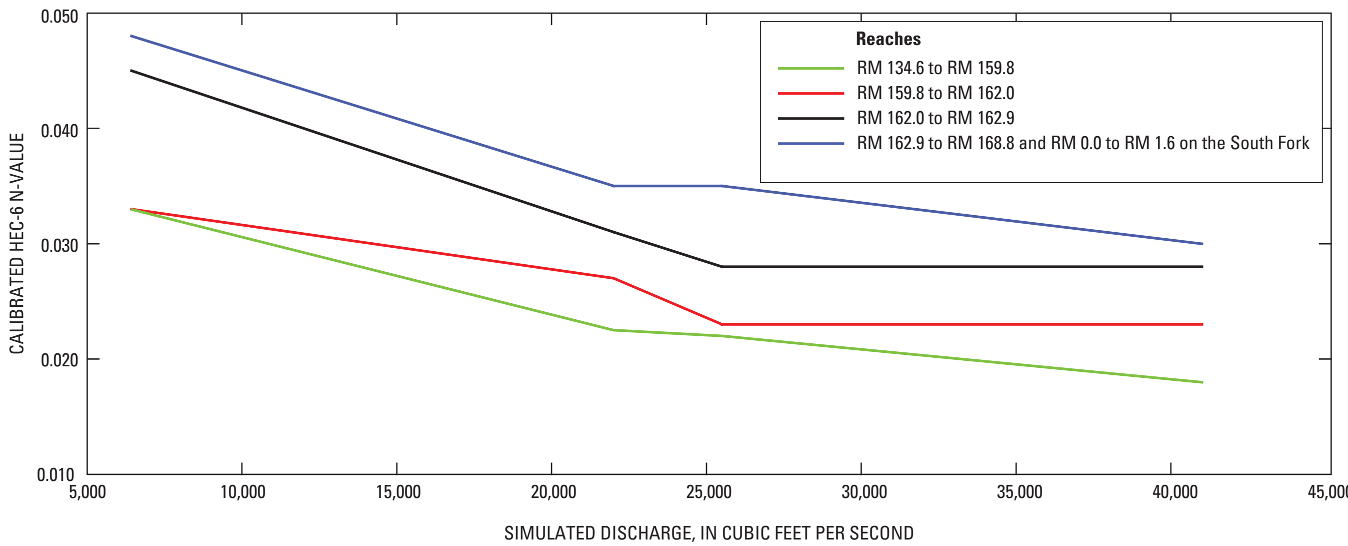


Figure 13. Calibrated Manning's *n* values (roughness coefficients) of the streambed for modeled reaches, Coeur d'Alene River, Idaho.

River discharge and stage data for calendar year 1999 also were simulated as a check on the reasonableness of sediment transport prior to attempting management simulations because no sediment-transport parameters were available to adjust in the HEC-6 model. Calendar year 1999 was selected because suspended-sediment samples were taken during that year and flow did not overtop banks and (or) levees. River discharges on the main stem were based on daily mean discharges at the Cataldo gaging station (12413500). River discharges for the NF and SF were based on the Enaville and Pinehurst gaging stations, respectively, for 1999. Water-surface elevations at the Harrison gaging station were calculated by adding the daily mean stage for 1999 to the NAVD 88 datum. The incoming total sediment discharges (Q_T) from the Enaville and Pinehurst gaging stations were estimated from Q_T curves shown in figure 12. A time step of 0.1 day was used requiring 3,650 iterations to complete the simulation for calendar year 1999.

Simulated HEC-6 sediment discharges for calendar year 1999 for sand transport (particle size equal to and greater than 0.00625 mm) are shown in figure 14. Measured and simulated sand transport were compared at the Rose Lake and Harrison gaging stations. Only sand transport was considered because sand particles are heavy enough to be deposited on the streambed, whereas clay and silt particles (considered the "wash load") have low settling velocities and thus are transported in suspension with few of these size classes deposited on the streambed. Generally, simulated and measured sand discharges agreed with one another (fig. 14). Additional sediment samples at Rose Lake and Harrison and other areas in the study reach are needed—especially at higher river discharges—and would enhance existing datasets and allow the extension of sediment rating curves. Additional sampling also would help to improve model accuracy, especially during higher discharges when most transport occurs.

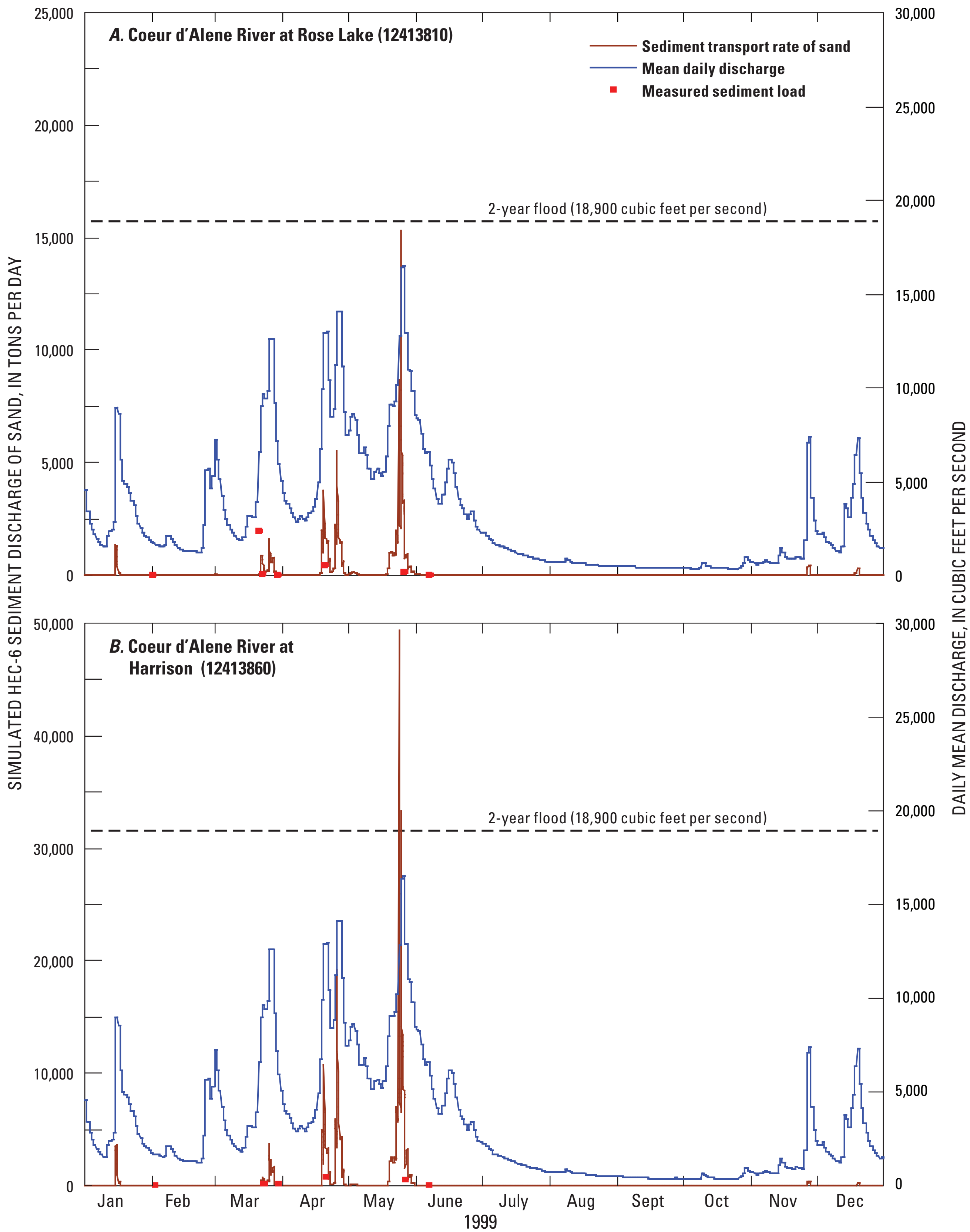


Figure 14. HEC-6 simulated and measured sediment sand discharge and daily mean discharge for calendar year 1999 at the Coeur d'Alene River at Rose Lake gaging station (12413810) and Coeur d'Alene River near Harrison gaging station (12413860), Coeur d'Alene River, Idaho.

Simulation of Erosion, Deposition, and Sediment Transport under Varying Conditions

The calibrated model was verified as capable of simulating water-surface elevations and also was reasonable in simulating sand sediment discharge. Therefore, it can be used to test management alternatives such as dredging the streambed. The model can simulate changes in water-surface elevations, sediment transport, and streambed elevations (erosion and deposition) resulting from various alternatives. The HEC-6 model provides a dredging option to remove sediments from the streambed. Sediment transport, aggradation, and (or) degradation in the modeled reach are important factors, especially for determining substrate quantity.

For this study, four management alternatives were simulated. The configuration of the streambed in the model for all four management alternatives was altered in the Dudley reach to simulate dredging of the river channel. In management alternatives 3 and 4, the incoming total sediment discharge from the SF was decreased by one-half. Stage and discharge data for calendar year 2000 were used in alternatives 1 and 3 because river discharge probably did not overtop banks and (or) levees in the Dudley reach, and one large single peak (mean daily discharge of 26,100 ft^3/s) was measured, which represents about a 4-year flood. The 4-year flood has a 25 percent chance of occurring in a given year. Stage and discharge data for calendar year 1997 were used in alternatives 2 and 4 because flows probably stayed within the confines of the channel in the Dudley reach, and several large peak flows were measured. The peak flows in 1997 were similar in magnitude to the single peak in 2000.

River discharges on the main stem were based on daily mean discharge at the Cataldo gaging station. Discharges on the NF and SF were based on the daily mean discharge at the Enaville and Pinehurst gaging stations, respectively, and water-surface elevations at Harrison gaging station were calculated by adding the daily mean stage to the NAVD 88 datum. On the main stem just downstream of the confluence of the NF and SF at cross section 167.676, discharges from both forks were added. Also on the main stem, daily mean discharge was added or subtracted near Kingston (cross section 166.729) to account for differences in daily mean discharge between the NF plus SF and the Cataldo gaging station. All simulations ran for one year using a time step of 0.1 day. An additional day was simulated in 2000 because it was a leap year.

Dredging in Dudley Reach

For management alternative 1, river discharge and stage data from calendar year 2000 were used in the simulation. The incoming total sediment discharges from the NF and SF were determined from the total sediment discharge curves (fig. 12) for the respective river discharges. Before the simulation began, the configuration of the streambed in the model was altered at seven cross sections (156.135, 156.213, 156.286, 156.351, 156.399, 156.454, and 156.504) in the Dudley reach to simulate dredging of the river channel. These changes resulted in about 296,000 yd^3 of streambed sediments being removed based on excavating about 20 ft of material over a 2,400 ft reach that averaged 175 ft in width. River discharge and model simulation results for sediment discharge for calendar year 2000 at cross section 156.504 (the upstream most cross section in the dredged reach) are shown in figure 15. Large amounts of sediment were transported on relatively few days in calendar year 2000 (fig. 15*A*). Model simulation results for April 15 showed that about 9,000 tons of sediment discharge were transported downstream of cross section 156.504. The peak flow of 26,100 ft^3/s also occurred on this day and represents about a 4-year flood.

Also, model simulation results showed that about 6,530 yd^3 of sediment were deposited in the dredged reach for 2000 (fig. 16), which represents 2.2 percent of the dredged sediments removed before the start of simulation. Thus for the long-term, it would take about 45 years to fill up the dredged reach to its original volume, assuming river conditions similar to 2000 occurred each year over that period. By the end of the simulation, the average increase in the streambed elevation in the Dudley reach was about 0.5 ft. The greatest increase in streambed elevation was about 1 ft at the upstream end of the dredged reach (fig. 16).

Because the 1D model does not simulate flow and sediment transport process on the floodplain, it is not clear how much erosion, deposition, and (or) sediment transport would occur in the channel due to flow that overtop banks. The flow that overtops banks along the Coeur d'Alene River probably is greater than the channel-forming discharge (bankfull flow) because of human influences, such as levees, along the river. Because no field data are available to determine bankfull flow along the Coeur d'Alene River, bankfull flow was estimated from flood frequency and was estimated to be the 2-year flood (18,900 ft^3/s). Leopold (1994) indicated that bankfull flow usually ranges between the 1.5- and 2.5-year floods.

For alternative 2, the channel configuration was altered the same as in alternative 1 to simulate dredging. This alternative used river discharges and stages from calendar year 1997 because several large peak flows occurred during the year and flows and river discharge probably did not overtop banks and (or) levees in the Dudley reach. In addition, twice as many days of consecutive flow equaled and (or) exceeded bankfull flow (18,900 ft^3/s) in 1997 than in 2000. The total flow volume in 1997 was 3 times greater than in 2000.The total flow volume for river discharges that equaled and (or) exceeded bankfull flow in 1997 was 2.3 times greater than in 2000. Nine days of flow exceeded bankfull flow in 1997 (fig. 15*B*). The highest daily mean flow in 1997 (25,300 ft^3/s) (fig. 15*B*) was not as high as in 2000 (26,100 ft^3/s) (fig. 15*A*).

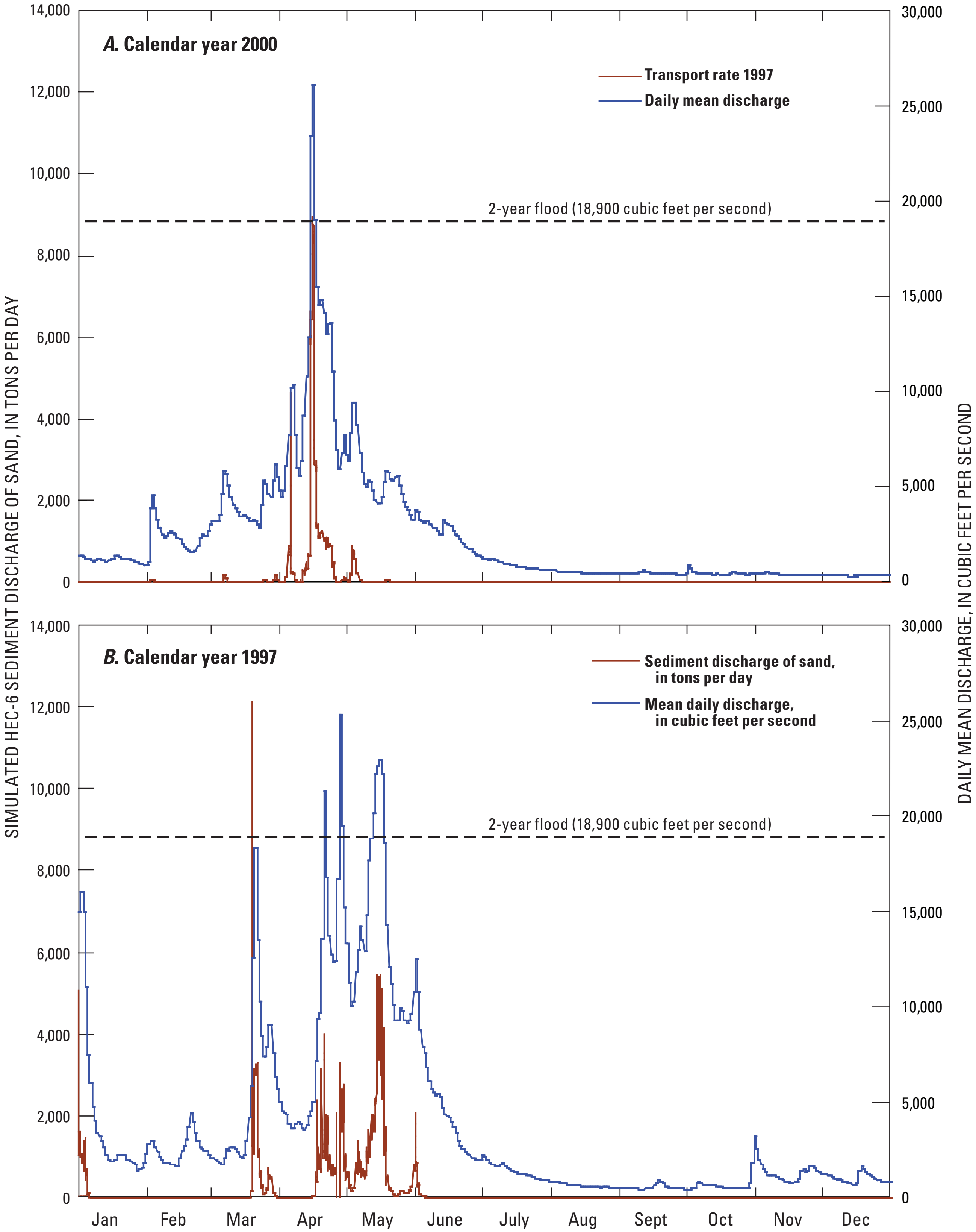


Figure 15. Simulated sediment discharge of sand and daily mean discharge at cross section 156.504 dredged reach for calendar years 2000 and 1997, Coeur d'Alene River near Dudley, Idaho.

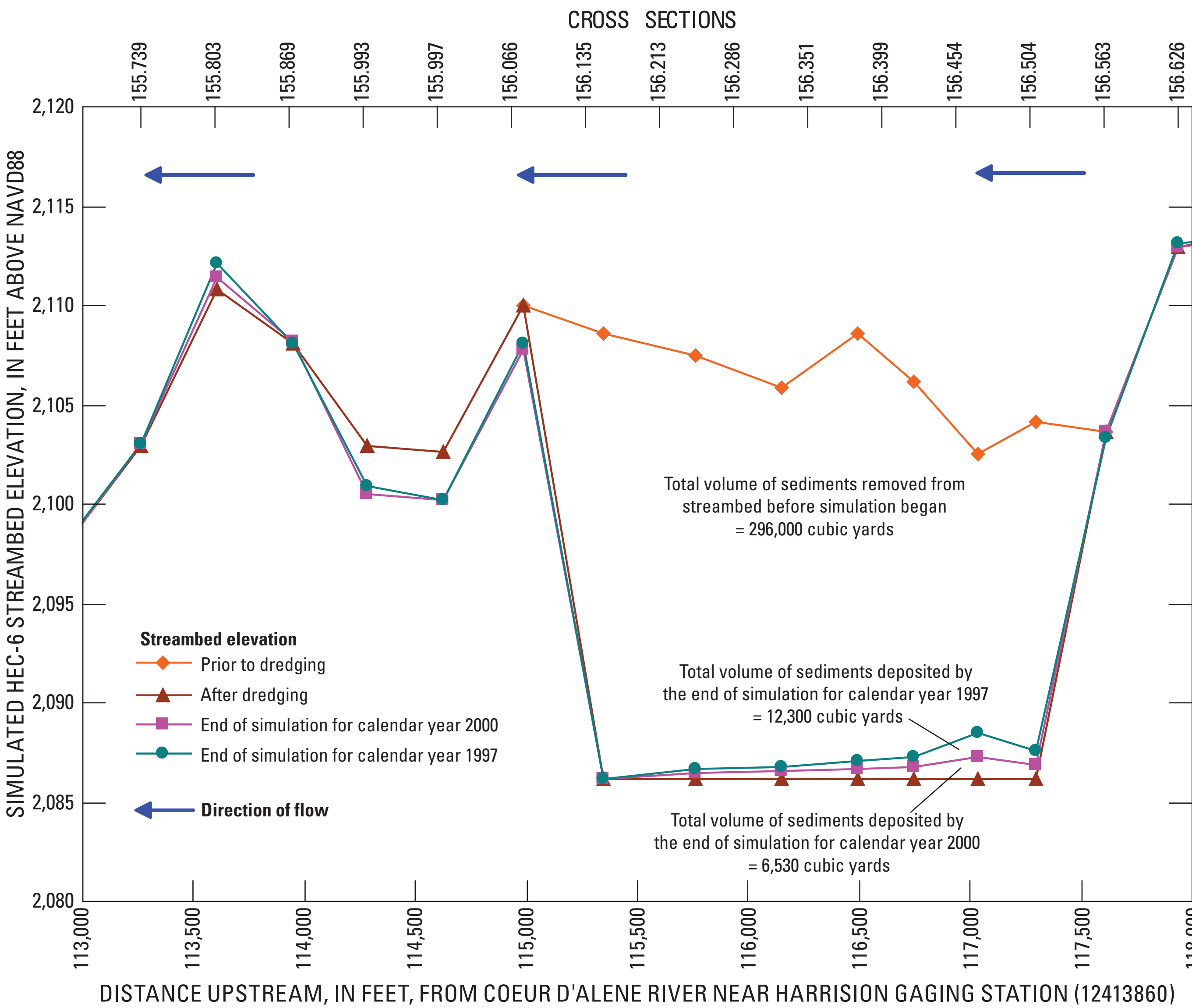


Figure 16. Simulated streambed elevations before and after streambed dredging and at the end of simulation for calendar years 2000 and 1997, Coeur d'Alene River near Dudley, Idaho. (Locations of cross sections are shown in appendix A.)

Model simulation results showed that the highest sediment discharge (about 12,000 ton/d on March 20) did not occur simultaneously with the highest peak flow of the year, but one day before the 4th highest peak flow. On the day of the highest peak flow (April 28), the simulated sediment discharge was ranked 7th out of 365 days. Model simulation results showed that about 12,300 yd^3 of sediment were deposited in the dredged reach for the year (fig. 16), which was twice as much that was deposited in 2000. This value represents 4.2 percent of the total volume that was removed before the start of simulation in the dredged reach. Therefore, it would take about 24 years to fill up the dredged reach to its original volume assuming river conditions similar to 2000 occurred each year over that period. The thickness of deposition at the end of the simulation averaged about 1 ft in the dredged reach with the thickest of about 2.5 ft (fig. 16).

Reduction in Sediment Discharge Input

Management alternative 3 applied the same river discharge, stages, and incoming total sediment discharge, and streambed elevation as those in alternative 1, except that the incoming total sediment discharge from the SF was decreased by one-half. Model simulation results for this alternative were similar to those for alternative 1 (2000) in the Dudley reach, dredged, and downstream reaches. The decreased incoming total sediment discharge had no effect on the streambed in the Dudley, dredged, or downstream reaches. The distance of the river between the SF and Dudley reach probably is long enough for the sediment supply, transport capacity, and channel geometry to be balanced for the given discharge and stage conditions before reaching Dudley.

Alternative 4 was simulated using the same river discharges, stages, and incoming total sediment discharges, and streambed elevation as in alternative 2 (1997) except that the incoming total sediment discharge from the SF was decreased by one-half, as in alternative 3. Model simulation results for this alternative were similar to alternative 2 for the Dudley reach. Again, the decreased incoming total sediment discharge from the SF had no effect on model simulation results in the Dudley, dredged, and downstream reaches.

Model Limitations

A computer model can be a useful tool for predicting water-surface and streambed elevations and sediment transport response to changes in the riverine system. However, the accuracy that a model can project water-surface and streambed elevations, and sediment transport is directly related to the accuracy and adequacy of the input data used to calibrate the model. The model limitations must be taken into account when using the model for projections.

The HEC-6 model contains many simplifying assumptions about the riverine system. Most important are the approximations of 1D flow, gradually varied flow, steady flow, movable streambed, and sediment transport. These simplifications might cause the model to calculate water-surface and streambed elevations and sediment transport with discharges greater than or less than experienced in actual study reach conditions. Overall, HEC-6 successfully calculated water-surface and streambed elevations and sediment transport in the Coeur d'Alene River. However, HEC-6 was not designed to account for uneven velocities in a cross section (especially in curved sections), uneven water-surface elevation in a cross section, or uneven erosion and deposition and sediment transport in a cross section. Also, HEC-6 does not provide the option to simulate infiltration losses and (or) gains in the channel.

The HEC-6 model cannot adequately simulate flow and sediment transport processes on the floodplain. Extreme events such as the 1996 flood that inundated the entire valley (channel and floodplains) cannot be simulated with this model and the effects are unknown. Also, the life expectancy of dredging from extreme events or bank overtopping flows is unknown. Only flows that stayed within the confines of the channel can be simulated with the HEC-6 model.

How velocity and sediment transport are distributed throughout the study reach evokes many questions that a 1D model like HEC-6 cannot answer. Applying multi-dimensional models that would simulate river discharge and sediment transport more precisely could refine velocity, bed shear stress, and sediment transport of the Coeur d'Alene River.

HEC-6 can simulate the transport of sediment sizes of 0.0625 mm (0.0025 in.) (very fine sand) and greater. The model can account for silt and clay particles less than 0.0325 mm (0.0013 in). However, shear threshold rates for clay and silt deposition and erosion were not available for the lower Coeur d'Alene River. These rates are site-dependent and may vary by orders of magnitude from one site to another; therefore, the results obtained from the model may not be reliable. Field measurements in the study reach are needed to determine actual shear threshold rates.

The particle size distribution of the streambed was limited to a few samples. Many more samples are needed throughout the study reach to characterize the streambed adequately. For the gravelbed reach, samples are needed of the armored layer and underneath the armor layer using specialized approaches for collecting samples with armored-surface layers as described in Berenbrock and Bennett (2005).

Suspended-sediment and bedload data were used to determine total sediment discharge at selected sites in the model. Since Clark and Woods' (2001) study, no bedload samples have been collected, and their bedload curves were used without modification. The bedload curve for Rose Lake gaging station was based only on three samples (Clark and Woods, 2001, fig. 17), and at the Harrison gaging station, no bedload sediments have been collected by the sampler even at a discharge of 25,500 ft^3/s. Thus, an assumption of zero bedload was made at the Harrison gaging station, which is unrealistic especially during higher discharges. Additional sediment samples at Rose Lake and Harrison gaging stations and at other areas in the study reach are needed and would enhance the existing dataset and allow for the extension of sediment rating curves. Additional sampling would help improve model accuracy especially during higher discharges when most transport occurs.

FASTMECH Model Implementation

Two-dimensional (2D) models are able to simulate uneven water-surface elevations, varying velocities, and flows in more than one direction in a cross section. These models can also simulate the flow curvature in bends or eddies, whereas, flow curvature is lost in 1D models. Two-dimensional models also can provide better-defined velocities and hydraulic and bed shear stresses than 1D models.

Therefore, the FASTMECH model, a 2D model, was used to simulate flow and hydraulic conditions for the Coeur d'Alene River in and around Dudley, Idaho.

FASTMECH is a computer program that analyzes 2D steady flow in channels and floodplains with a fixed bed. FASTMECH is a steady-state model using a structured curvilinear grid, based on the 2D, vertically averaged, shallow water equations (McDonald and others, 2001; Nelson and others, 2003; Simões and McDonald, 2004; and McDonald and others, 2006). The model also calculates the vertical distribution of the primary and secondary velocities about the vertically average velocity. These data help calculate the shear stress near the bed (τ_b). Vertical velocity distributions were estimated rather than computed from the shallow water equations; nevertheless, they add a partial dimensionality to the model. Thus, the FASTMECH model is designated as a two and one-half dimensional (2.5D) model.

The FASTMECH implementation encompassed the channel between RM 154 to RM 159 (fig. 17), a distance of 5.3 mi. The streambed in this model was assumed to be fixed and sediment-transport processes were not simulated. Nevertheless, bed and critical shear stress can be used for estimating sediment mobility, a surrogate of potential deposition and erosion. FASTMECH was recently applied to an 11-mi reach of the Kootenai River near Bonners Ferry with several sharp bends and split flow around an island (Barton and others, 2005). The model successfully simulated measured water-surface elevations and cross-stream velocities especially in bends. FASTMECH also has successfully simulated other rivers and floodplains (Conaway and Moran, 2004; Kenney, 2005; and Kinzel and others, 2005).

FASTMECH assumes flow is steady and incompressible. It also assumes flow is hydrostatic (neglecting vertical accelerations), and turbulence is treated adequately by relating Reynolds stresses to shear using an isotropic eddy viscosity (Nelson and others, 2003). Another FASTMECH assumption is that flow is unobstructed and free of debris in the channel and floodplain. The model uses only the International System (SI) of units. The SI system uses the metric system and meter of length, kilogram of mass, and second of time as its fundamental units.

FASTMECH was the first model incorporated into the Multi-Dimensional Surface Water Modeling System (MD_SWMS) (McDonald and others, 2001; and Simões and McDonald, 2004). MD_SWMS is a graphical user interface for pre- and post-processing application for computational models of surface-water hydraulics. MD_SWMS can be used to build, edit, and run models and view model inputs and results. The interface and additional information are accessible at http://wwwbrr.cr.usgs.gov/projects/SW_Math_mod/OpModels/MD_SWMS/index.htm.

Model Grid and Bathymetric Interpolation

The model grid used in FASTMECH is a curvilinear orthogonal coordinate system with a user-defined centerline. The grid centerline approximates the mean flow streamline in the modeling reach (Nelson and others, 2003) that was defined interactively in MD_SWMS. The computational grid used to model the Coeur d'Alene River was 8,452 m (27,730 ft or 5.3 mi) long with 3,371 nodes in the streamwise direction. The width was 350 m (1,148.3 ft) with 141 nodes in the cross-stream direction. This formed an approximately 2.5 × 2.5 m (8.2 × 8.2 ft) grid (fig. 17). Nodes are located at the corners of each grid, and 475,311 nodes form the computational grid.

A module in MD_SWMS was used to map bathymetry and LIDAR data to each node or coordinates of the model grid through a "nearest-neighbor" method. Bathymetry for each node was interpolated by a search bin that covered a predefined downstream length and cross-stream width. By choosing the length and width of the search bin judiciously, the user can tune the interpolation to treat situations where slopes in the cross-stream direction are steeper than slopes in the streamwise direction as frequently observed in alluvial rivers. Node interpolation includes all bathymetry and LIDAR data points in a search bin. If the search bin contains no data, the length and width of the search bin is doubled until at least one or more data points are found. Elevations of points in the search bin are weighted by distance from the node and averaged to obtain a value for each node of the grid. This approach works well where channel banks are nearly parallel to the grid as was the case for the modeled reach.

Model Boundaries

The FASTMECH model requires specific input parameters for each simulation. At the upstream boundary, the model requires river discharge. Discharge at the upstream boundary was based on discharge data from only the Cataldo gaging station (12413500). Flows from intervening drainages between the Cataldo gaging station and upstream model boundary are small compared to the river discharge in the main stem and were considered negligible in the model.

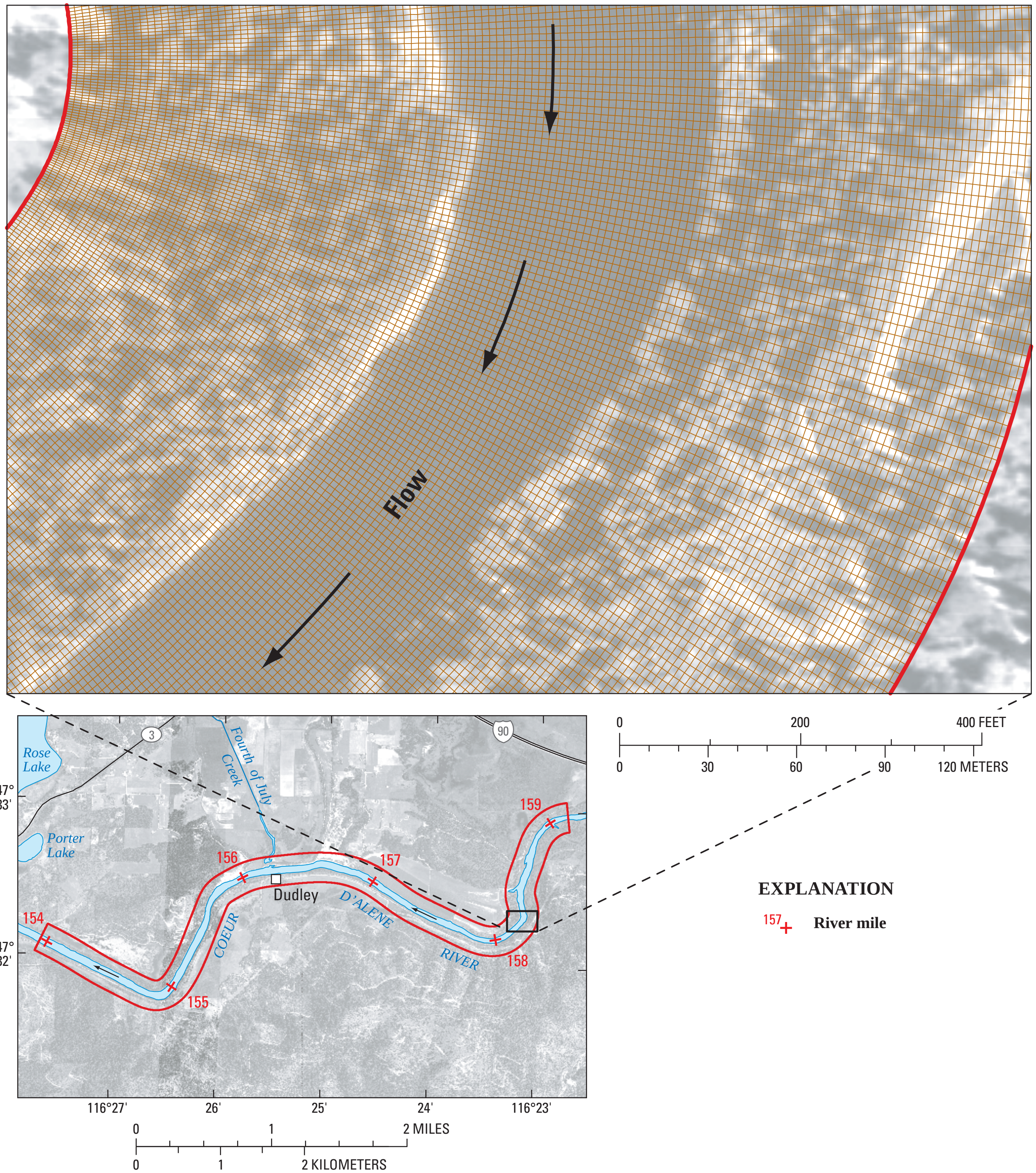


Figure 17. Model grid of the multi-dimensional flow model, Coeur d'Alene River near Dudley, Idaho.

Water-surface elevations at the downstream boundary were based on results from the HEC-6 model in a fixed-bed mode (see section on "HEC-6 Implementation" for more information on the HEC-6 model). Downstream water-surface elevations in the HEC-6 model were based on adding stage data from the Rose Lake gaging station (12413810) and the NAVD 88 datum. Boundary conditions for the calibration simulations are presented in table 5.

Model Calibration

Calibration for a 2.5D model is similar to the calibration for a 1D model. A graphical and statistical model-calibration module contained in MD_SWMS allows for calibration with measured water-surface elevations and (or) velocities. To calibrate FASTECH, the drag coefficient was adjusted iteratively until simulated water-surface elevations matched measured water-surface elevations at selected sites. Physically, this process ensures the roughness used in the model accurately simulates head losses in the channel. Because measured values of water-surface elevations and velocities were not available, water-surface elevation values from FASTMECH were compared to HEC-6 at each cross section in the 5.3-mi modeled reach. No measured velocities were available for the calibration simulations, and thus, no additional adjustments were made to the drag coefficient because of velocity. For these calibrations, the model was run for 3,000 iterations, sufficient to achieve computational stability. Model calibration was considered acceptable when the difference between FASTMECH and HEC-6 water-surface elevations for each cross section was within the ±0.15 ft limit.

FASTMECH was calibrated to five historical discharge and water-surface elevation conditions (table 5). Selection of historical conditions for model calibration was based on two criteria. The first criterion was availability of water-surface elevation data at the Rose Lake gaging station (12413810). Second, because FASTMECH is a steady-state model, the historical discharge and water-surface elevation should be stable in the modeled reach for a minimum of 24 hours so river conditions approximate steady flow. Calibrated water-surface elevations at the downstream boundary ranged from about 2,130 ft to about 2,139.4 ft, and river discharges used in the calibration ranged from 10,500 to 28,900 ft^3/s (table 5).

Each node was assigned an initial drag coefficient based on the roughness coefficient (Manning's *n*) from the HEC-6 model. An equivalent Manning's *n* value to the drag coefficient can be calculated using a depth scale from the following equation:

$$n = 1.515\sqrt{C_d\left(\frac{H^{1/3}}{g}\right)} \quad , \qquad (1)$$

where

n is the Manning's roughness value,
C_d is the dimensionless drag coefficient,
H is the mean depth of flow, in ft, and
g is the constant for acceleration of gravity, in ft/s^2.

Table 5. Boundary conditions for FASTMECH model calibrations, Coeur d'Alene River near Dudley, Idaho.

[**Water-surface elevation at the downstream boundary** was determined from HEC-6 model. **Abbreviations:** ft^3/s, cubic foot per second; ft, foot]

Model calibration simulation No.	Date	Discharge at upstream boundary (ft^3/s)	Water-surface elevation at downstream boundary (ft)
1	03-26-99	10,500	2,133.19
2	01-15-99	14,000	2,130.15
3	05-26-99	17,300	2,134.97
4	05-14-97	22,860	2,139.43
5	04-14-00	28,900	2,137.45

The following example shows how using equation 1 estimated the initial drag coefficient. The fourth calibration simulation was used for this example, with a river discharge of 22,860 ft^3/s and a daily mean water-surface elevation at the Rose Lake gaging station (12413810) of 2,139.43 ft (table 5). The HEC-6 model was simulated in a fixed-bed mode with these conditions. From the graph in figure 13, a Manning's *n* coefficient for a river discharge of 22,860 ft^3/s in the 2.5D modeled reach was interpolated to be 0.0224 for the streambed. From HEC-6 results, mean depth for the 2.5D modeled reach was 20.6 ft. Therefore, using equation 1, C_d was computed to be 0.0026. An initial C_d was computed for each calibration simulation and applied uniformly throughout the modeled reach.

FASTMECH also incorporates a lateral eddy viscosity to represent lateral momentum exchange due to turbulence or other variability not generated at the bed (Nelson and others, 2003). The following equation can be used to compute the initial lateral eddy viscosity:

$$LEV = 0.01 \times \bar{U} \times \bar{H} \quad , \qquad (2)$$

where

LEV is the lateral eddy-viscosity coefficient, in m^2/s,
$\bar{U}$ is the average velocity, in m/s, and
$\bar{H}$ is the mean depth of flow, in m.

Continuing with the previous example, the mean depth ($\bar{H}$) of flow is 20.6 ft. From HEC-6 results, average velocity for the modeled reach was 2.6 ft/s. The computed *LEV* value for this example is 0.16 m^2/s. An initial *LEV* was computed for each calibration simulation and applied uniformly throughout the modeled reach.

Results of Calibration Simulations

Instead of measured water-surface elevation data, calibration simulations used water-surface elevation data derived from comparison of FASTMECH (simulated) and HEC-6 results. Comparisons between models were made at cross sections and at the center river node for the FASTMECH model. Differences in water-surface elevation between FASTMECH and HEC-6 were less than 0.15 ft, except at cross section 158.634 in simulation 5 (0.18 ft). Calibration results are shown in table 6 and figure 18. The mean absolute difference (MAD) error was small for all simulations. Water-surface elevations from FASTMECH and HEC-6 compared favorably (fig. 18). Along the middle part of the 2.5D reach from RM 156.5 to RM 158.5, water-surface elevations in FASTMECH were slightly less than elevations in HEC-6. Differences also were greater at lower discharges. Only drag coefficients (C_d) were adjusted during calibration.

Calibrated C_d values for each simulation are shown in table 6. The calibrated value in simulation 4 was slightly higher than the initial value and greater than all other simulations probably because the influence of backwater was greater due to the high lake stage. Water-surface elevation at the downstream boundary of the 2.5D model was about 2 ft higher in simulation 4 than in simulation 5, which had a greater river discharge (table 5). Table 6 also shows calibrated *LEV* values for each calibration simulation. The calibrated value in simulation 4 was lower than the initial value. This was true for all calibration simulations.

Results from the calibration simulations also included depth, velocity, bed shear stress, and sediment mobility. Each respective simulation used boundary conditions listed in table 5 with each respective simulation.

Flow Depth

Simulated flow depths for river discharges of 10,500, 14,000, 17,300, 22,860, and 28,900 ft^3/s are shown in figure 19. Usually depths increased as river discharge increased except for simulation 4 where the high lake levels in Coeur d'Alene Lake caused high water-surface elevations in the river due to backwater conditions. Water-surface elevation at the downstream boundary was about 2 ft higher in simulation 4 than in simulation 5 (table 5). However, river discharge in simulation 5 was about 6,000 ft^3/s greater than in simulation 4. Simulated water-surface elevations throughout the modeled reach were higher in simulation 4 than in simulation 5. Therefore, flow depths were greater in simulation 4 than in simulation 5. The reach from RM 157.0 to RM 157.7 was the shallowest in all simulations (fig. 19), and the average simulated depth along the thalweg ranged from 16 ft in simulation 1 to 25.6 ft in simulation 4. The deepest point of the modeled reach occurred near RM 158.3 near a riverbed, and depths ranged from 43 ft in simulation 1 to 53 ft in simulation 4. In the dredged reach between cross sections 156.066 and 156.563, average depth along the thalweg ranged from 21 ft in simulation 1 to about 31 ft in simulation 4 (fig. 19).

Flow Velocity

Simulated flow velocities for river discharges of 10,500, 14,000, 17,300, 22,860, and 28,900 ft^3/s are shown in figure 20. Simulated velocities increased as river discharges increased. Average simulated velocities along the thalweg ranged from about 3 ft/s in simulation 1 to 5.3 ft/s in simulation 5; maximum simulated velocities ranged from 3.9 ft/s in simulation 1 to about 7 ft/s in simulation 5.

Table 6. Calibrated drag coefficient and lateral-eddy viscosity and differences between model simulated and observed HEC-6 water-surface elevations for five calibrations, Coeur d'Alene River near Dudley, Idaho.

[**Abbreviations:** m^2/s, square meter per second; ft, foot; MAD, mean absolute difference error; (see figure 16 for equation); MD, maximum difference]

Model calibration simulation No.	Date	Dimensionless drag coefficient (C_d)	Lateral eddy viscosity (*LEV*) (m^2/s)	Water-surface elevation differences between simulated (FASTMECH) and observed (HEC-6)	
				MAD (ft)	MD (ft)
1	03-26-99	0.0022	0.05	0.037	0.102
2	01-15-99	.0022	.05	.035	.092
3	05-26-99	.0022	.05	.050	.131
4	05-14-97	.0030	.05	.043	.100
5	04-14-00	.0023	.15	.062	.177

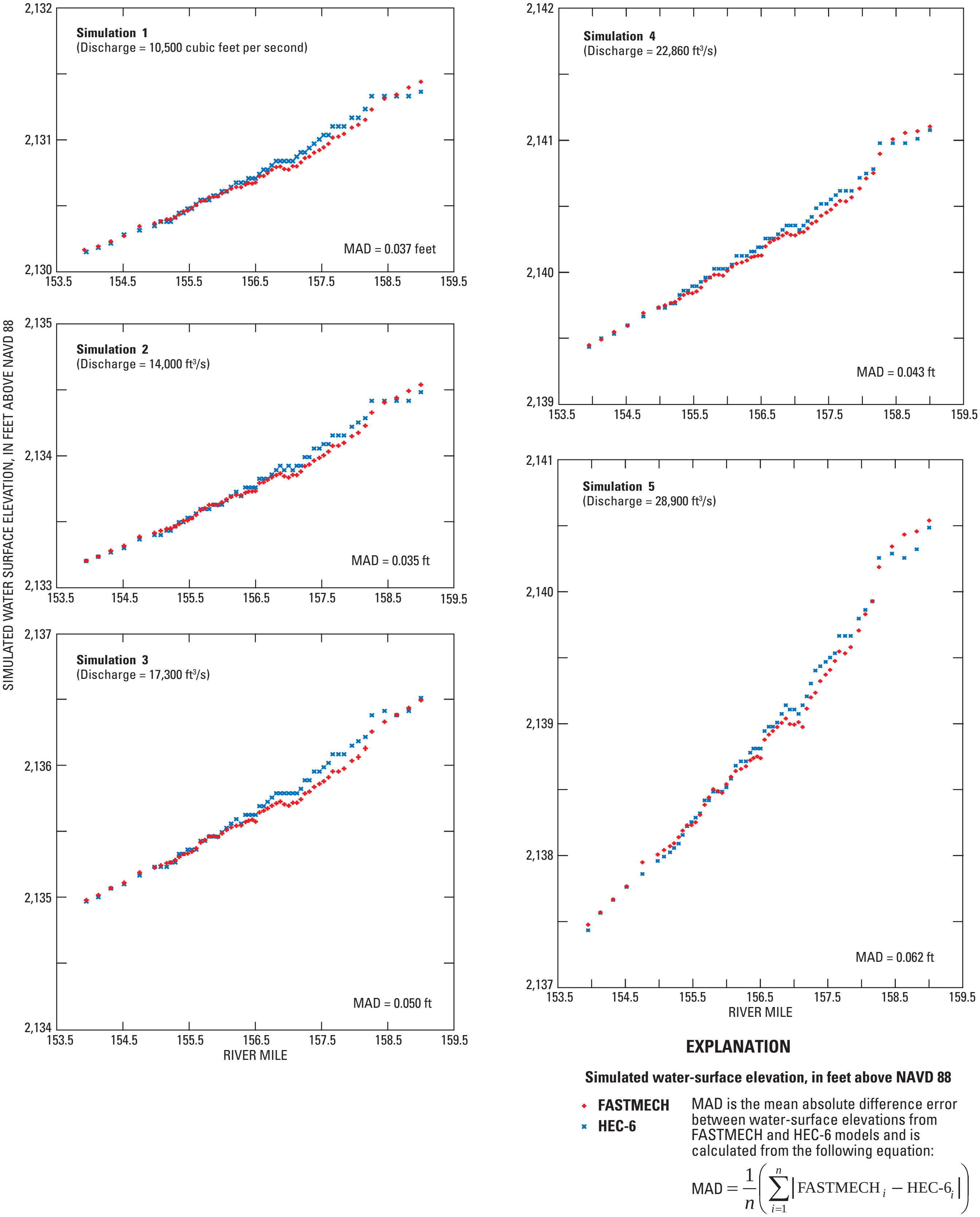


Figure 18. Simulated water-surface elevations from FASTMECH and HEC-6 models and mean absolute difference error, Coeur d'Alene River near Dudley, Idaho.

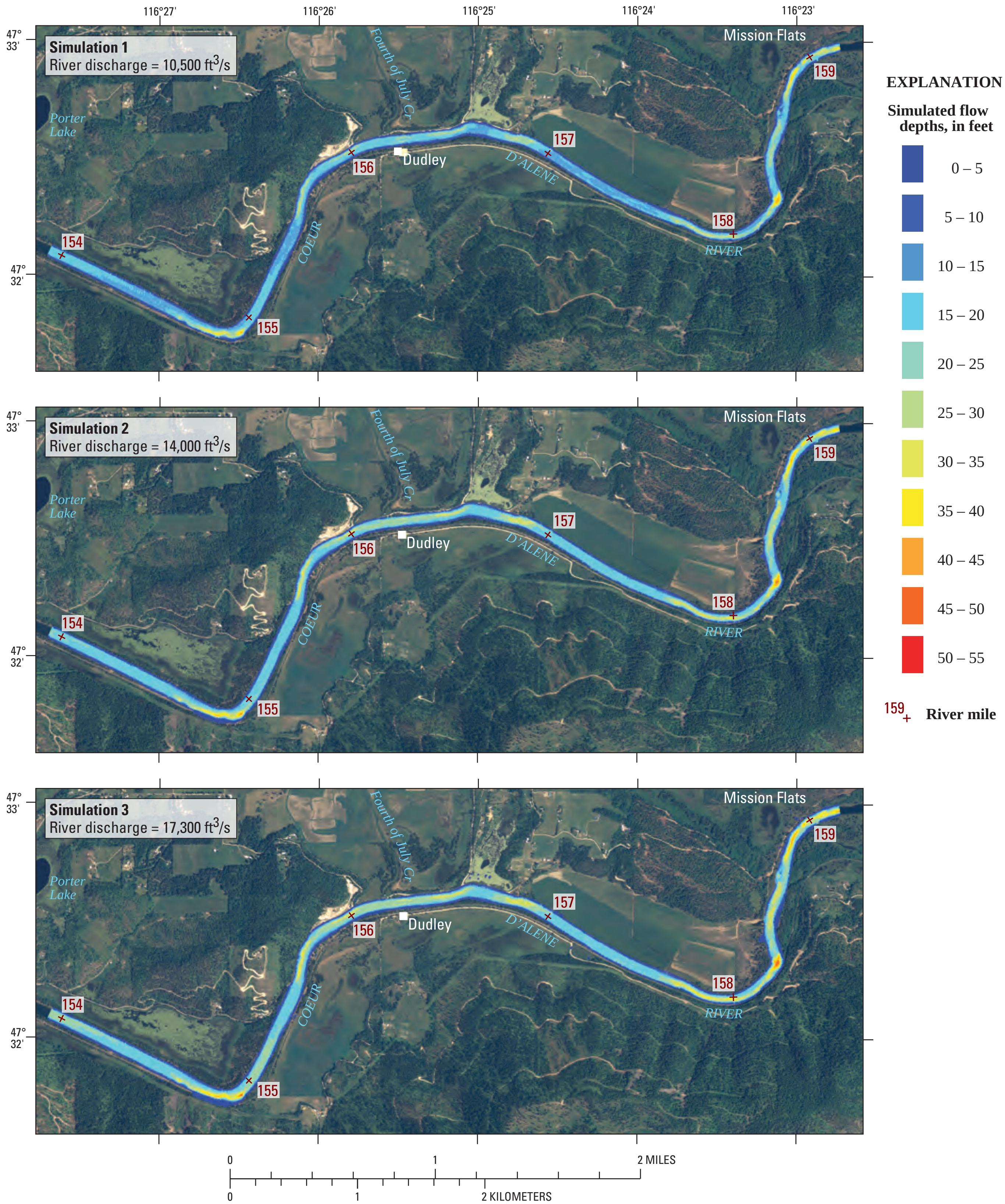


Figure 19. Simulated depths from FASTMECH for five calibration simulations, Coeur d'Alene River near Dudley, Idaho.

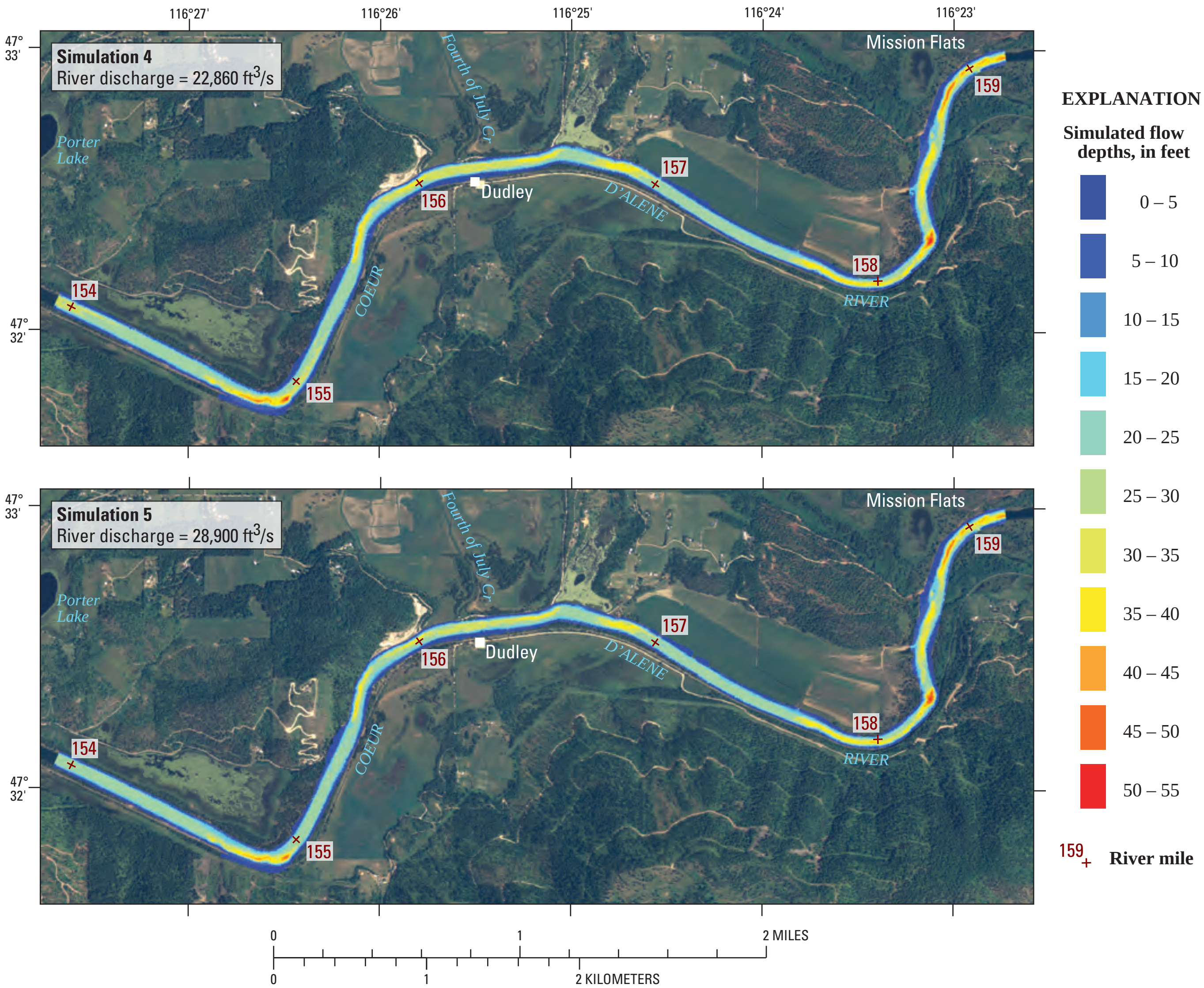


Figure 19.—Continued.

Velocities in simulation 4 were similar to velocities in simulation 3 because of the substantial backwater conditions in simulation 4 resulting from the high lake levels. In all simulations, the highest velocities occurred in the reach between RM 157.0 to RM 157.7 where flow depth is shallowest. In this reach, average velocity along the thalweg ranged from 3.5 ft/s in simulation 1 to about 6 ft/s in simulation 5. At the deepest point of the modeled reach (near RM 158.3), average simulated velocity ranged from 4 ft/s in simulation 1 to about 6 ft/s in simulation 5. In the dredged reach, from cross section 156.066 to section 156.563, average velocity along the thalweg was 2.75 ft/s in simulation 1 and 5 ft/s in simulation 5.

Velocity also can be described by magnitude and direction (vectors), whereas, velocity as described above was expressed only by magnitude (speed). Vectors usually are drawn as arrows pointing in the direction of flow with arrow color and (or) size depicting the speed of flow. Vectors of velocity are helpful in depicting the flow direction especially in reverse flows. Figure 21 shows velocity vectors of the dredged reach near Dudley. In the modeled reach, the vectors are nearly parallel except near banks and in and around river bends. The vectors also show that the highest velocities are near the center of the river probably aligned with the thalweg except in and around river bends. The maximum velocity at cross section 156.213 was 5.8 ft/s and average velocity

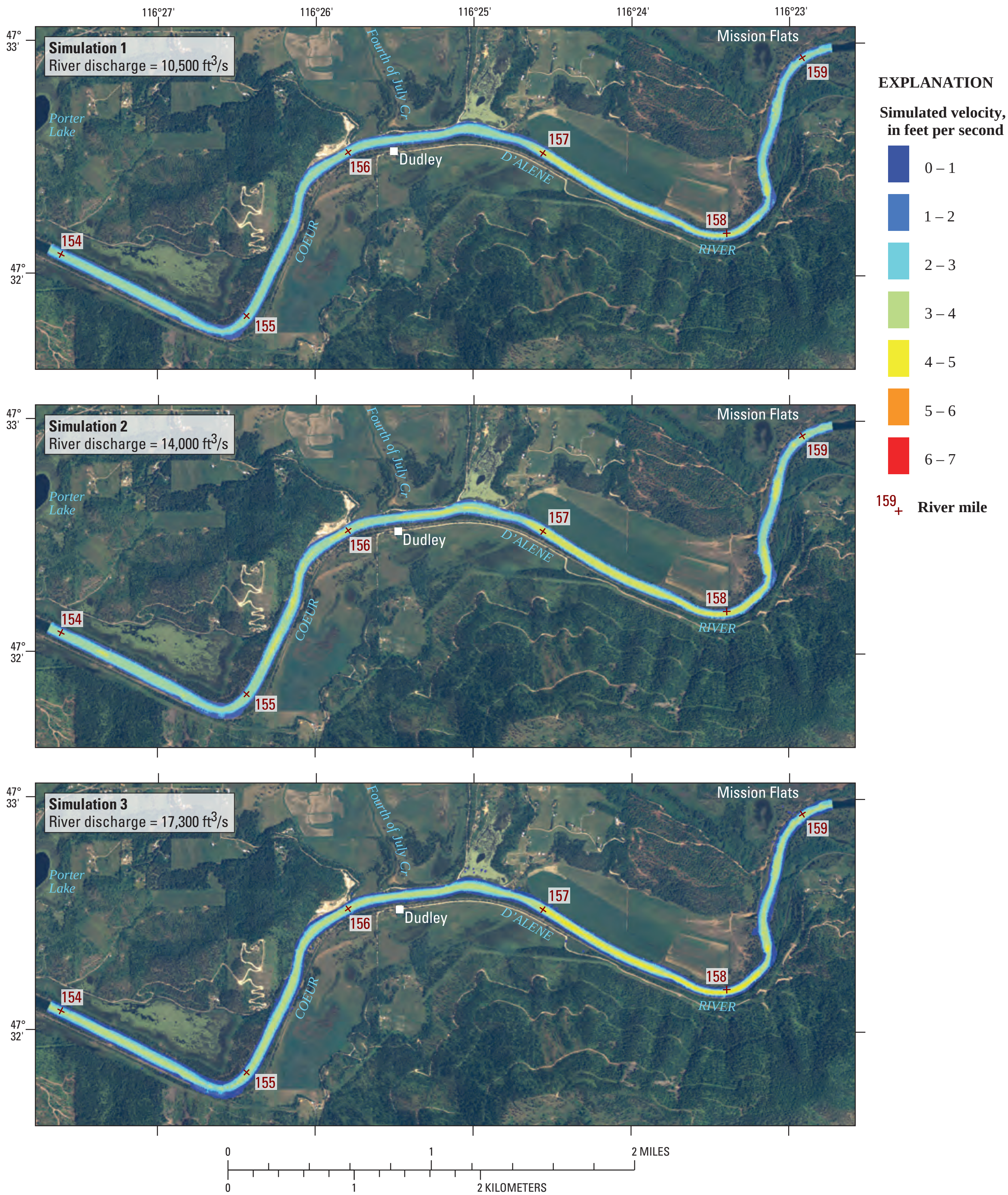


Figure 20. Simulated velocities from FASTMECH for five calibration simulations, Coeur d'Alene River near Dudley, Idaho.

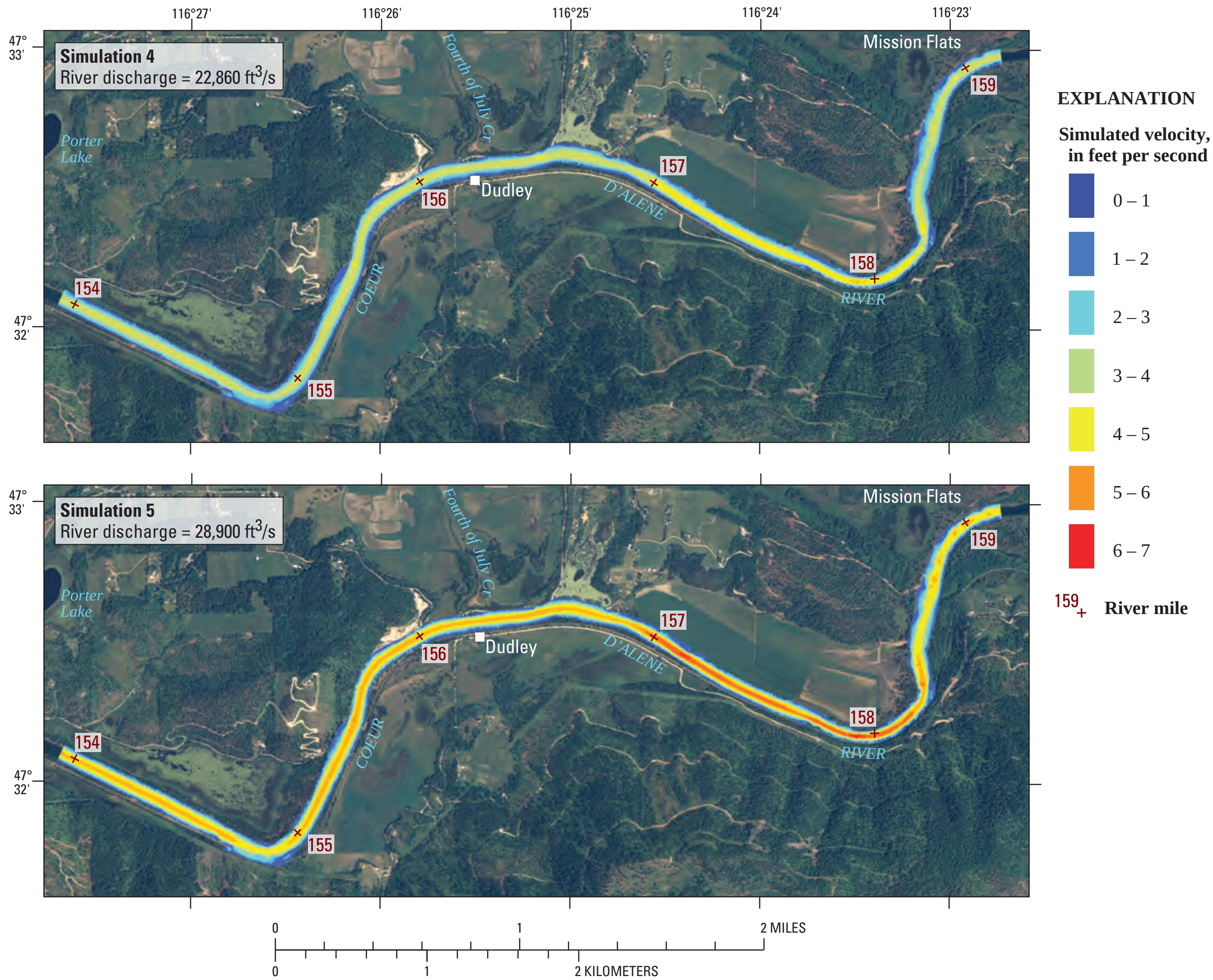


Figure 20.—Continued.

was 3.5 ft/s, a decrease of 40 percent (fig. 21). On average, maximum velocities at cross sections shown in figure 21 (cross sections 156.135, 156.213, 156.286, 156.351, and 156.399) were about 60 percent greater than average velocity.

FASTMECH simulated several reverse flows (back-eddies). Several back-eddies occurred in a bend in the river near cross section 158.259 with a river discharge of 28,900 ft^3/s (fig. 22). A large back-eddy near the left bank was about 120 ft wide and about 500 ft long and encompassed about one-third of the river width. Flow depth in the center of the eddy at cross section 158.259 was about 45 ft. Average flow depth throughout the eddy was about 22 ft. FASTMECH also simulated two other back-eddies on the right bank (fig. 22) . These back-eddies were much smaller in size and flow depths were much shallower. Other simulated back-eddies in the modeled reach were much smaller than the large back-eddy at RM 158.3. No back-eddies were simulated by the model in the dredged reach (fig. 21). Back-eddies usually trap sediment and debris because of swirling or circular flows and slow velocities. If the velocities are slow enough, the sediments settle out.

In contrast to the multidimensional (FASTMECH) model, the 1D model (HEC-6) did not show or simulate eddies—even though a large eddy near cross section 158.259 occupies about one-third of the river (fig. 22). This deficiency illustrates why a 1D model is not appropriate for this reach. In 1D space, variables can have only one value. For example, a 1D hydraulic model can have only one value for each variable (velocity, water-surface elevation, shear stress, etc.) at a cross section.

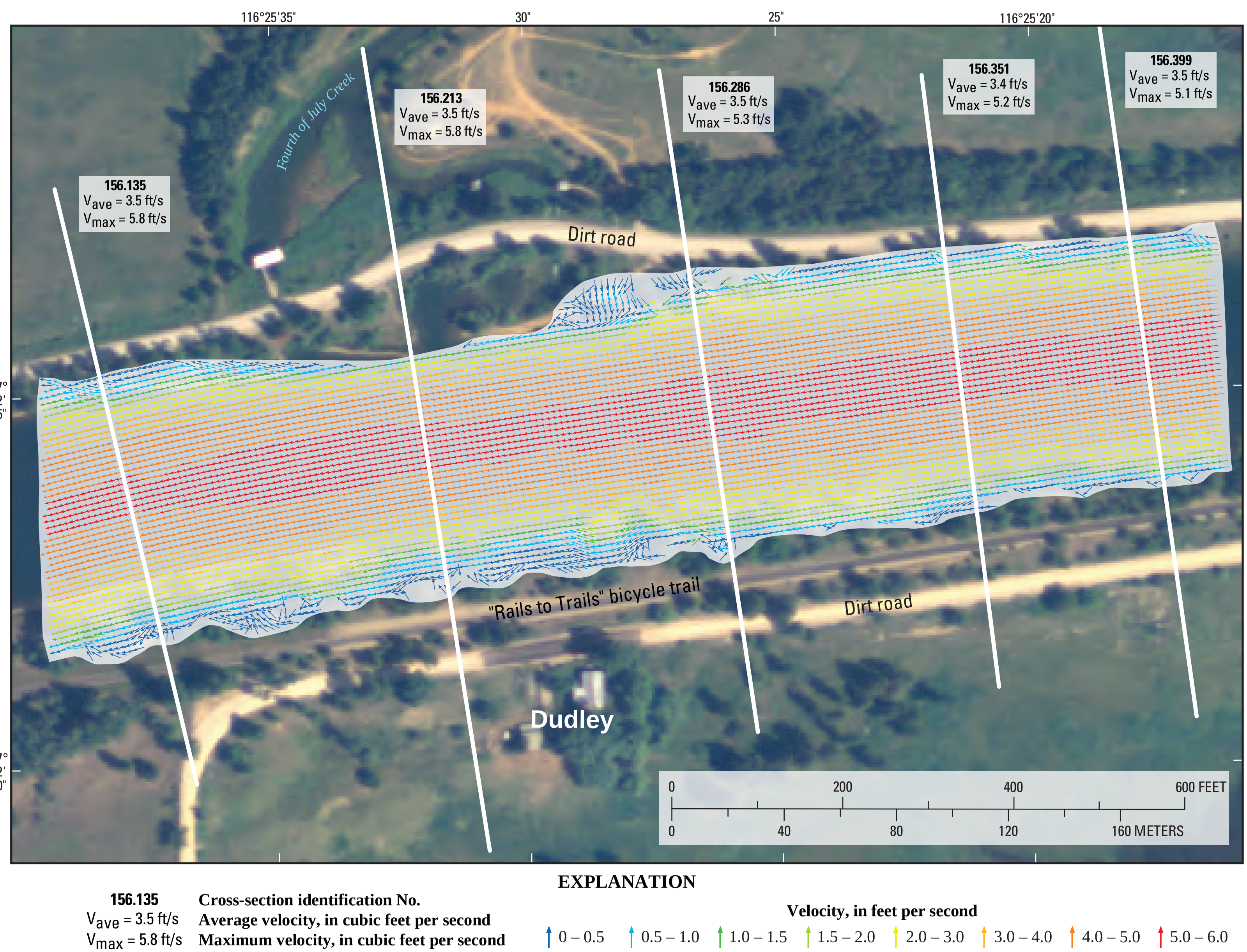


Figure 21. Velocity vectors and average and maximum velocities at cross sections for a river discharge of 28,900 cubic feet per second in the dredged reach, Coeur d'Alene River near Dudley, Idaho.

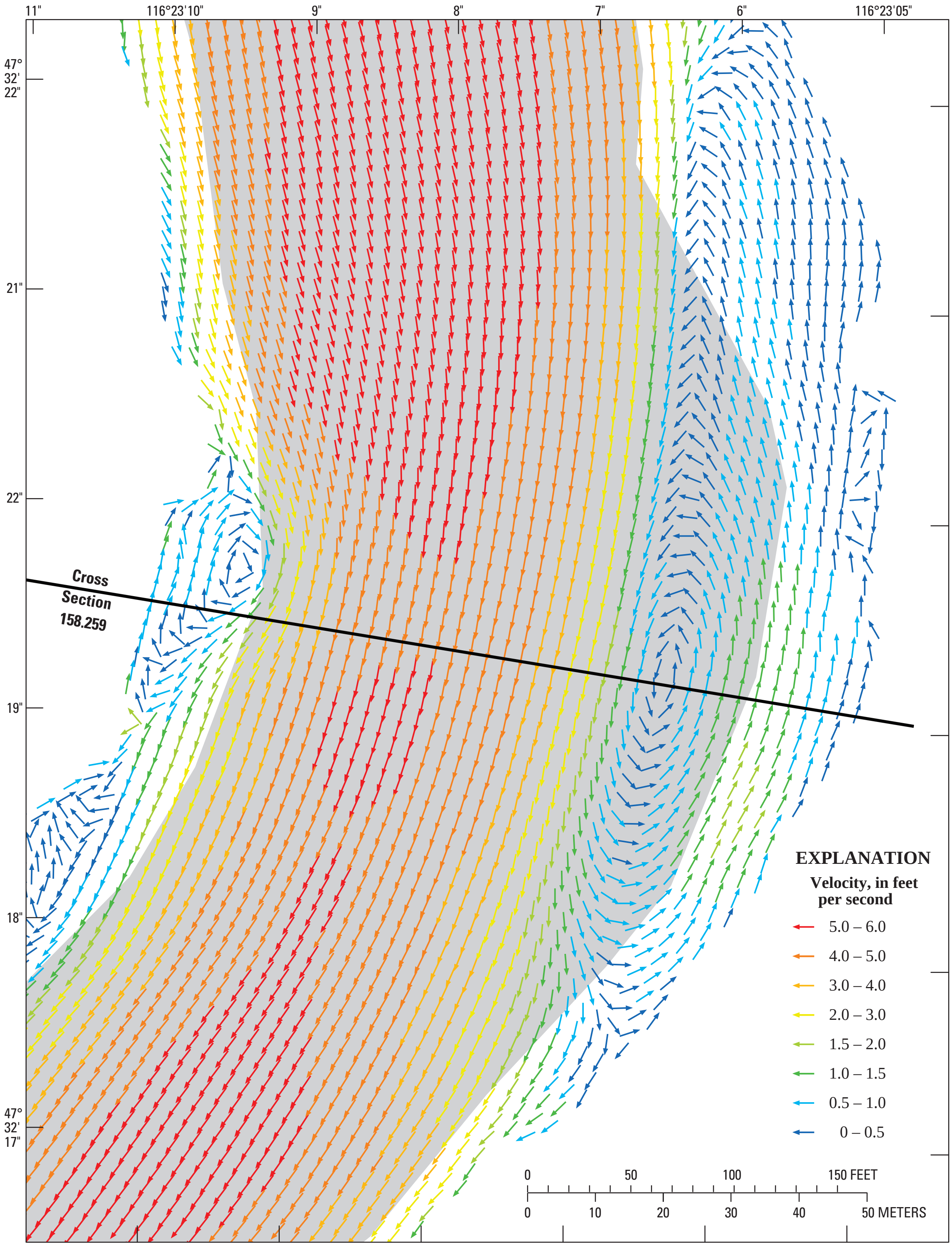


Figure 22. Velocity vectors for a river discharge of 28,900 cubic feet per second in a river bend near cross section 158.259, Coeur d'Alene River near Dudley, Idaho.

Rivers with eddies and other complex flow features cannot be expressed adequately in 1D space; therefore, multi-dimensional models are needed to simulate the river more precisely as shown in figure 22.

Shear-Stress

Shearing forces associated with river discharge, known as shear stress, determine the capability of a river to move material. Noncohesive sediment movement occurs when the boundary threshold is exceeded (Julien, 2002). The threshold is referred to as the critical shear stress. FASTMECH calculates boundary or bed shear stress as:

$$\tau_b = \rho C_d (u^2 + v^2) \quad , \tag{3}$$

where

- τ_b is the boundary or bed shear stress, in Newtons per square meter (N/m^2),
- ρ is the density of water, in kilograms per cubic meter (kg/m^3),
- C_d is the drag coefficient, dimensionless,
- u is the vertically averaged streamwise velocity, in m/s, and
- v is the vertically averaged cross-stream velocity, in m/s.

Simulated bed shear stress for river discharges of 10,500, 14,000, 17,300, 22,860, and 28,900 ft^3/s are shown in figure 23. Simulated bed shear stress increased as river discharge increased. Average simulated bed shear stress ranged from 1.1 N/m^2 in simulation 1 to 3.3 N/m^2 in simulation 5. The maximum stress ranged from 3.3 N/m^2 in simulation 1 to 10 N/m^2 in simulation 5 with the highest stresses usually occurring in the river bend near RM 158. In the reach with the highest velocities and shallowest flow depths (RM 157.0 to RM 157.7), average stress along the thalweg ranged from 2.4 N/m^2 in simulation 1 to 7.6 N/m^2 in simulation 5. At the deepest point of the modeled reach (near RM 158.3), bed shear ranged from 3.2 N/m^2 in simulation 1 to about 8 N/m^2 in simulation 5. In the dredged reach, average stress along the thalweg ranged from 1.6 N/m^2 in simulation 1 to 5.3 N/m^2 in simulation 5, an increase greater than 200 percent.

Sediment Mobility

The model-simulated bed shear stress also was used to assess sediment mobility over the five calibration simulations. River discharges for these simulations ranged from 10,500 to 28,900 ft^3/s. Sediment mobility for a given particle size occurs when the boundary or bed shear stress (τ_b) exceeds the critical shear stress (τ_c), in other words $\tau_b > \tau_c$. This determines only whether a given particle size is potentially mobile. Sediment mobility provides an indication whether sediment movement (transport) occurs. However, bed erosion and deposition also depends on sediment supply. Sediment mobility is computed from flow depth and bed shear stress.

The following equation was used to determine critical shear stress for particle motion:

$$\tau_c = \theta^* (s-1)\rho g d_{50} \quad , \tag{4}$$

where

- τ_c is the critical bed shear stress, in N/m^2,
- θ^* is the Shields parameter for the given particle size, dimensionless,
- s is the specific gravity of the particles and is calculated as the ratio of specific weight of sediment (γ_s) to the specific weight of water (γ), dimensionless,
- ρ is the density of water, in kg/m^3,
- g is the constant for acceleration of gravity, in m/s^2, and
- d_{50} is the median particle size, in m.

The Shields diagram provided the Shields parameter θ^* for each particle size. Table 7 shows critical shear stresses and Shields parameter for the particle-size classifications of table 3. For example, critical shear stress for medium sand ranged from 0.194 to 0.27 N/m^2.

In sandbed channels where bedforms are present, such as the meander reach of the Coeur d'Alene River, total bed shear stress can be comprised of many components (McLean, 1992). Thus, for determining only the shear that is acting on the particles or grain, partitioning bed shear stress (τ_b) is necessary. Grain shear stress is the resistance due to sediment grains on the streambed and is responsible for the movement of sediment. The following equation was used to determine grain shear stress from total shear stress (Smith and McLean, 1977; and Nelson and others, 1993; Bennett, 1995, equation 9):

$$\frac{\tau'_o}{\tau_b} = \frac{1}{1 + \left(\frac{C_d}{2\kappa^2} \frac{\Delta}{\lambda} \left(\ln \left(\frac{0.368\Delta}{z_o} \right) \right)^2 \right)} \quad , \tag{5}$$

where

- τ'_o is the grain shear stress, in N/m^2,
- τ_b is the bed shear stress, in N/m^2,
- C_d is the drag coefficient, dimensionless, and typically has a value of 0.2,
- κ is von Karman's constant and typically has a value of 0.4,
- Δ is the wave length of the bedform and (or) dune, in m,
- λ is the wave height of the bedform and (or) dune, in m, and
- z_o is the roughness height, in m, and is defined as $z_o = 0.12\ d_{84}$ (McLean, 1992), where d_{84} is the diameter at which 84 percent of the particles by weight of the sample is finer, in m.

Table 7. Critical shear stress by particle-size classification for determining approximate condition for sediment mobility at 20 degrees Celsius.

[Modified from Julien, 1998, table 7.1. Sediment mobility for a given particle size occurs when the bed shear stress exceeds the critical shear stress. This only determines whether or not a given particle size is mobile. **Critical bed shear stress** (τ_c) calculated from equation 4 using particle diameters from this table. **Abbreviations:** ϕ, phi scale where $\phi = -\log_2$ (diameter in mm); mm, millimeter; N/m^2, Newtons per square meter]

Particle classification name	Ranges of particle diameters		Shields parameter (dimensionless)	Critical bed shear stress (τ_c) (N/m^2)
	ϕ	mm		
Coarse cobble	-7 – -8	128 – 256	0.054 – 0.054	112 – 223
Fine cobble	-6 – -7	64 – 128	0.052 – 0.054	53.8 – 112
Very coarse gravel	-5 – -6	32 – 64	0.05 – 0.052	25.9 – 53.8
Coarse gravel	-4 – -5	16 – 32	0.047 – 0.05	12.2 – 25.9
Medium gravel	-3 – -4	8 – 16	0.044 – 0.047	5.7 – 12.2
Fine gravel	-2 – -3	4 – 8	0.042 – 0.044	2.7 – 5.7
Very fine gravel	-1 – -2	2 – 4	0.039 – 0.042	1.3 – 2.7
Very coarse sand	0 – -1	1 – 2	0.029 – 0.039	0.47 – 1.3
Coarse sand	1 – 0	0.5 – 1	0.033 – 0.029	0.27 – 0.47
Medium sand	2 – 1	0.25 – 0.5	0.048 – 0.033	0.194 – 0.27
Fine sand	3 – 2	0.125 – 0.25	0.072 – 0.048	0.145 – 0.194
Very fine sand	4 – 3	0.0625 – 0.125	0.109 – 0.072	0.110 – 0.145
Coarse silt	5 – 4	0.0310 – 0.0625	0.165 – 0.109	0.0826 – 0.110
Medium silt	6 – 5	0.0156 – 0.0310	0.25 – 0.165	0.0630 – 0.0826
Fine silt	7 – 6	0.0078 – 0.0156	0.3 – 0.25	0.0378 – 0.0630

This analysis determines whether or not a given grain size is mobile, but does not calculate potential for erosion or deposition, which is determined by the divergence or convergence in the sediment transport rate, and is not addressed in this analysis.

Grain shear stress is determined in equation 5 by using dune height and length for a related river discharge. Because dune heights and lengths were not measured during the study, bathymetric data were used to determine if dunes existed in the 2D modeled reach. The only well-formed and continuous bedforms in the modeled reach were located near the downstream end of the modeled reach between RM 154 to RM 154.5. These dunes extended longitudinally and transversely (across) in the channel. Dune heights and lengths in this reach averaged 1.1 and 63 ft, respectively. Dunes of partial extent (ill-formed) also occurred in other areas of the model reach. Bedform geometry is dependent on the flow and sediment characteristics and sediment transport rate, and measurements of bedform geometry at different river discharges would help improve the accuracy of grain shear stress and sediment mobility potential.

Therefore, the average height and length of dunes from the bathymetry data near the downstream end of the modeled reach were used to determined grain shear stress and sediment mobility in the Dudley reach. Bed shear stress in the Dudley reach averaged 5.7 N/m^2 in simulation 5 (river discharge of 28,900 ft^3/s). From equation 5, grain shear stress is calculated to be 3.5 N/m^2 which corresponds to the largest particle size of 5.1 mm that can be mobilized. Because of the uncertainty in dune characteristics, grain shear stress was calculated for a range of dune heights and lengths—0.5 times (decreasing), 1.0 times, and 1.5 times (increasing). If the dune height was not 1.1 ft, but was 1.65 ft (1.5 times) (1.1 ft × 1.5 = 1.65 ft), grain shear stress would be 2.8 N/m^2 and the largest mobilized particle would correspond to 4.1 mm; similarly, if only dune length was increased 1.5 times to 94.5 ft (63 ft × 1.5 = 94.5 ft), grain shear stress would be 4.0 N/m^2 and largest mobilized particle would correspond to 5.7 mm. Because of the uncertainty in dune characteristics, grain shear stress was calculated for a range of dune heights and lengths—0.5 times (decreasing), 1.0 times, and 1.5 times (increasing). Table 8 shows grain shear stress, corresponding largest mobilized particle, and associated particle classification name for 0.5, 1.0, and 1.5 times dune height and (or) dune length for simulation 5 (river discharge, 28,900 ft^3/s) based on an average bed shear stress of 5.7 N/m^2 in the Dudley reach. Changes in grain shear stress were less than 3 times from one to another (table 8). If no bedforms existed in the Dudley reach, grain shear stress would be equivalent to the bed shear stress (5.7 N/m^2) and the largest mobilized particle would correspond to 8 mm. Appendix D provides grain shear stress, largest mobilized particle, and particle classification for simulations 1 through 5. In simulations 1 through 5, areas of greater sediment mobility occurred near the thalweg where bed shear stresses (fig. 23) were greater; areas of lower sediment mobility occurred near the banks and back-eddies where bed shear stress were lower.

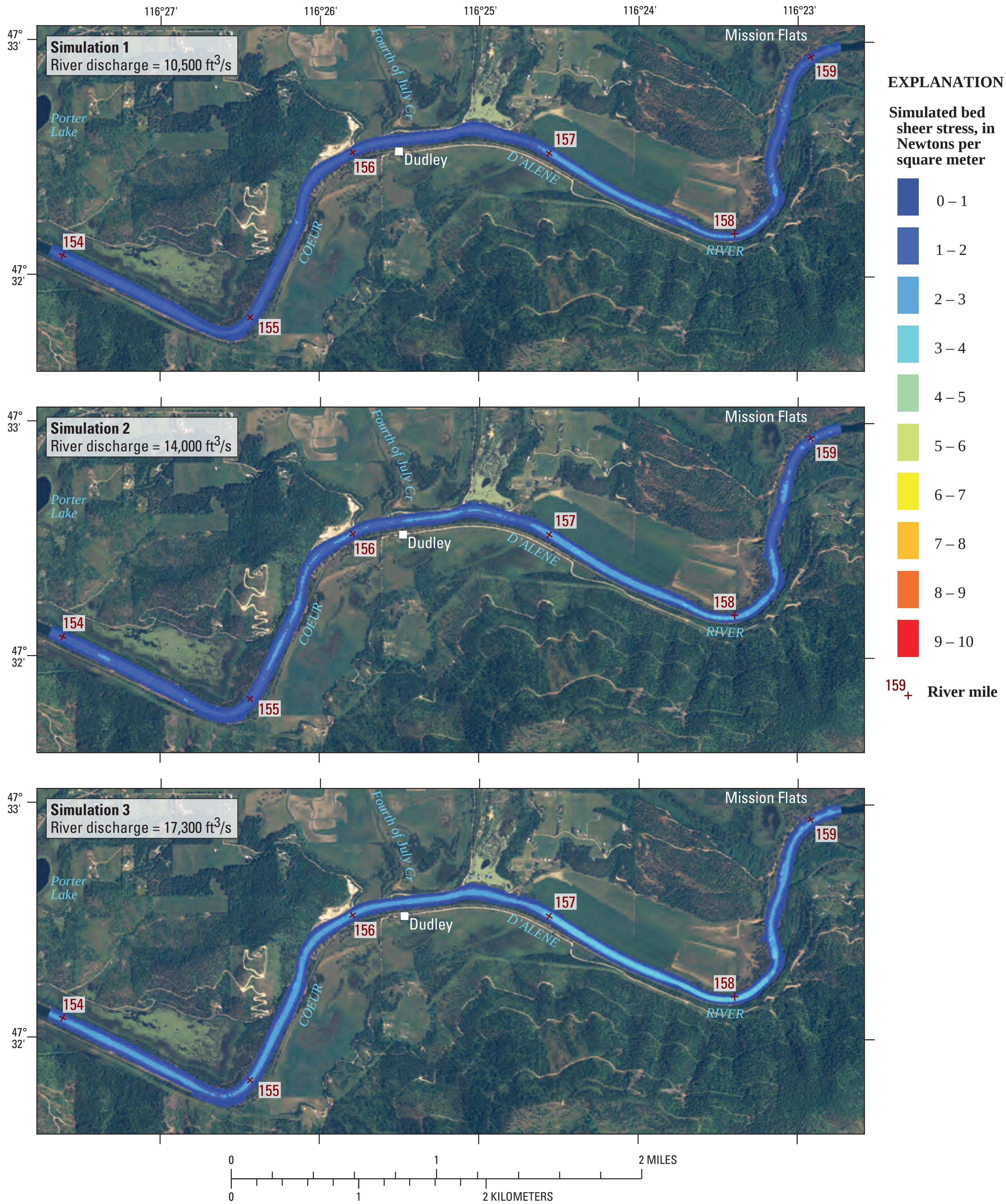


Figure 23. Simulated bed shear stresses from FASTMECH for five calibration simulations, Coeur d'Alene River near Dudley, Idaho.

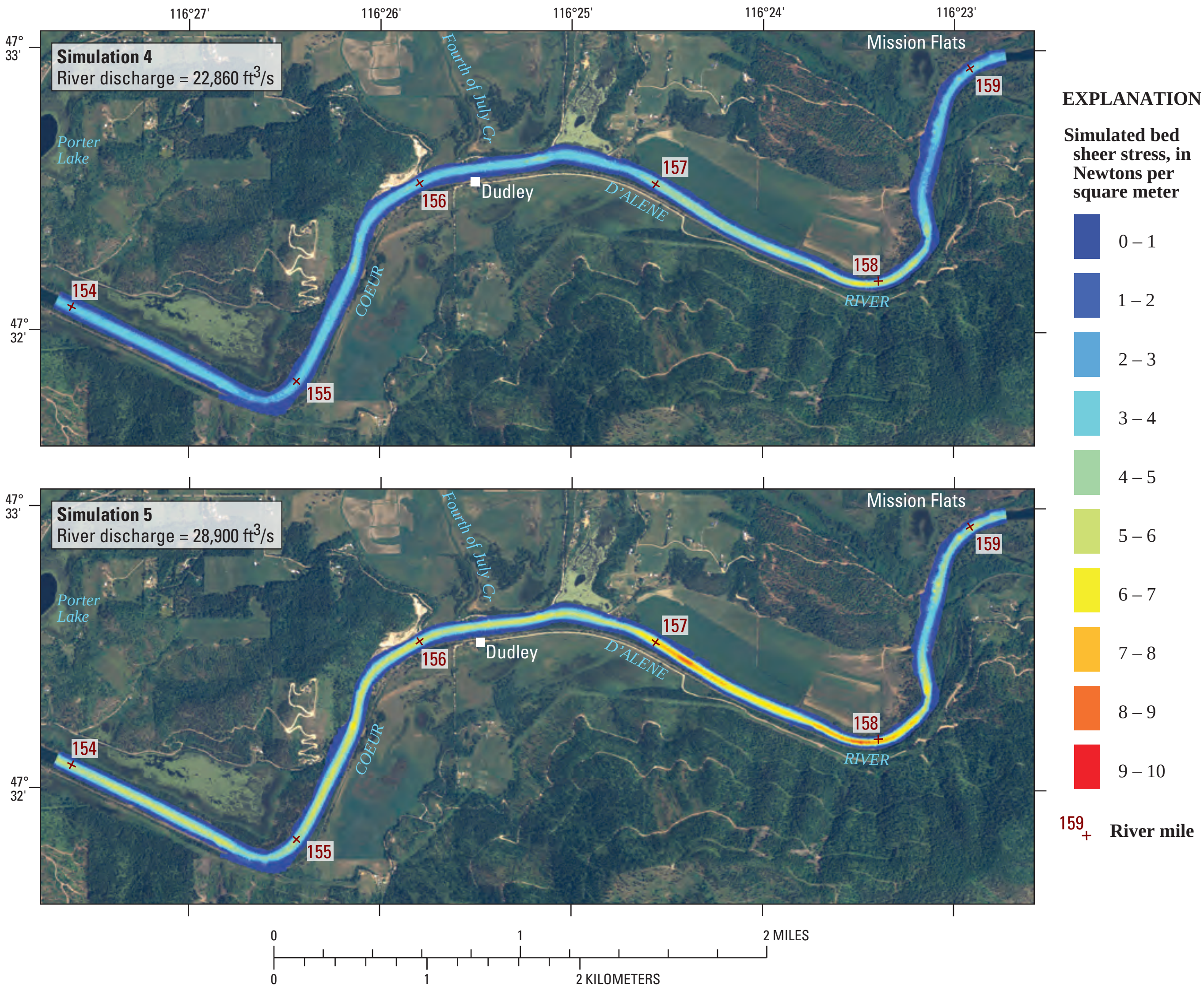


Figure 23.—Continued.

Table 8. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for simulation 5 (river discharge, 28,900 cubic feet per second), Coeur d'Alene River near Dudley, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)]

Model simulated results Average τ_b = 5.7 N/m^2 Maximum τ_b = 6.7 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 3.7 N/m^2 d_a = 5.3 mm Fine gravel	τ'_o = 4.5 N/m^2 d_a = 6.4 mm Fine gravel	τ'_o = 4.9 N/m^2 d_a = 6.9 mm Fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 2.5 N/m^2 d_a = 3.0 mm Very fine gravel	τ'_o = 3.5 N/m^2 d_a = 5.1 mm Fine gravel	τ'_o = 4.0 N/m^2 d_a = 5.7 mm Fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 1.8 N/m^2 d_a = 2.8 mm Very fine gravel	τ'_o = 2.8 N/m^2 d_a = 4.1 mm Fine gravel	τ'_o = 3.4 N/m^2 d_a = 4.9 mm Fine gravel

Model Limitations

Several factors constrain the ability of the FASTMECH model to simulate water-surface elevations, velocities, bed shear stresses, and sediment mobility: (1) accuracy and detail of channel and bank geometry, (2) characterization of water-surface elevations and velocities, (3) characterization of bedform geometry, (4) potential errors incurred by applying a steady-state model to unsteady flow conditions, and (5) the 2D flow approximations.

FASTMECH was calibrated to the results from a 1D model, which limits the accuracy potential of the 2.5D model to that of a 1D model. The existing model calibration and any future model calibrations would benefit from the acquisition of actual water-surface elevations and velocities throughout the modeled reach for several river discharges to improve the accuracy of the model simulation results. Velocity conditions at the upstream model boundary profoundly affect flow for roughly the upper 0.5 mi of the model. Additional discharge measurements at several river discharges could help to determine the velocity distribution across the upstream boundary. Measurements of the bedform for a range of river discharges are needed to enhance estimates of grain shear stress and sediment mobility potential. Collection of particle-size distribution data along the streambed and banks also could enhance future model calibrations. This information would help to improve the accuracy of the modeled results especially for bed shear stress and sediment mobility potential, and thereby using the full potential of the 2.5D model.

A calibrated, transient, hydrodynamic model could provide a more thorough understanding of velocities, bed shear stresses, and channel evolution. Steady-state models, such as the one presented here, are unable to evaluate the effects of changing flow and lake-level conditions on bed sediment mobility. To better understand channel evolution, a transient-state, 2D sediment transport model would be beneficial. Also, this model is limited to river discharges contained within the banks and those flood flows that overtop the banks and spread onto the floodplain would have to be addressed by a multi-dimensional floodplain model with sediment transport capability.

Summary

The Coeur d’Alene River originates in the Coeur d’Alene and St. Joe Mountains near the Idaho-Montana border and flows westward into Coeur d’Alene Lake. At the headwater of the river, elevations in the Coeur d’Alene Mountains reach 6,650 ft. The basin drains an area of about 1,475 mi^2 and consists of two branches, the North Fork (NF) and the South Fork (SF). These rivers reach a confluence downstream of Enaville, and then the main stem follows a sinuous path to the lake. The study reach is about 35 mi long, starting near the towns of Enaville and Pinehurst and continuing downstream to Springston near the river inlet to the lake. More than 100 years of mining in the upper Coeur d’Alene River Basin have resulted in large quantities of metal-contaminated sediments transported to and deposited in the lower Coeur d’Alene River and its floodplain.

In the study reach, the Coeur d’Alene River is characterized by a braided reach and a meander reach. The braided reach extends upstream of river mile (RM) 159.8 near Mission Flats, and the meander reach extends downstream from RM 159.8 to the river inlet. Many exposed islands and (or) bars are in the braided reach and divide the river into multiple channels especially at low flows; the streambed primarily is composed of gravels and cobbles. The meander reach is a single channel with gentle bends except at RM 135.25 and RM 149. The streambed in the meander reach primarily is composed of sand and silt and is contaminated with heavy metals transported from mine tailings in the SF basin. Previous studies have shown the highest concentration of contaminated sediments is in the streambed in the lower Coeur d’Alene River. Some of the highest concentrations of lead in the streambed are in the Dudley reach.

A computer sediment-transport model, HEC-6, was used to simulate water-surface and streambed elevations, erosion and deposition of the streambed, and sediment transport. This steady-state, 1D model simulates the resultant erosion and deposition averaged across the streambed at any cross section in the river reach. The model was calibrated to water-surface elevations and discharges at four historical stage-discharge conditions. Model calibration was considered acceptable when the difference between measured and simulated water-surface elevations was ±0.15 ft. Actual differences were ±0.11 ft, except for one value. Also, the model was used to simulate river discharges and stages for calendar year 1999 as a check on the reasonableness of sediment transport. Measured and simulated sand transport were compared at the Harrison and Rose Lake gaging stations, and the comparisons generally agreed with one another.

The calibrated model was used to evaluate the feasibility and potential effects of remedial actions (management alternatives) on the streambed. Four management alternatives were simulated to understand effects from dredging the streambed and reducing sediment discharge input. Management alternatives 1 and 3 used river discharge and stage data from calendar year 2000, and alternative 2 and 4 used data from calendar year 1997. Calendar year 2000 was simulated because flows stayed within the confines of the channel, and only one large peak flow (representing about a 4-year flood) occurred during that year. Calendar year 1997 was simulated because flows stayed within the confines of the channel, and several large peak flows occurred. Also, twice as many consecutive days that exceeded bankfull flow occurred during calendar year 1997 than during 2000. Before the start of simulation in these alternatives, seven cross sections in the Dudley reach were deepened 20 ft to simulate dredging. About 296,000 yd^3 of streambed sediments were removed by dredging.

Results from simulation 1 showed sediments being deposited in the dredged reach. About 6,530 yd^3 of sediments were deposited during 2000, about 2 percent of the total volume that was dredged. Thus, about 45 years of stage-discharge conditions similar to those that occurred in calendar year 2000 would be needed to fill up the dredged reach. For simulation 2 (1997), about 12,300 yd^3 of sediment was deposited in the dredged reach, about twice as much as in 2000. About 24 years of stage-discharge conditions similar to those that occurred in calendar year 1997 would be needed to fill up the dredge reach.

For alternative 3, model conditions in simulation 1 (2000) were used except that the incoming total sediment discharge from the SF was decreased by one-half. Results from this simulation showed neither differences in deposition nor in the elevation of the streambed from alternative 1 in the dredged and Dudley reaches because of the reduction of incoming total sediment discharge. The distance between the SF and Dudley reach is long enough for the sediment supply, transport capacity, and channel geometry to be balanced with river discharge before reaching the Dudley reach. Alternative 4 used the same model conditions as those used in alternative 2 (1997), except that the incoming total sediment discharge from the SF was decreased by one-half. Results from this simulation also showed no differences in deposition or streambed elevation between alternatives 2 and 4 in the dredged and Dudley reaches. It may take many years or even decades for the river to reach equilibrium conditions after incoming total sediment discharge is decreased. Effects from extreme events such as the 1996 flood (about a 100-year flood) on the channel and floodplain are unknown.

The FASTMECH computer model was used to increase understanding of two-dimensional flow hydraulics, in particular velocities and shear stresses, as they vary across the channel and in river bends. The model covers a 5.3-mile reach near Dudley, between river miles 153.9 and 159.2. The U.S. Geological Survey Multi-Dimensional Surface Water Modeling System (MD_SWMS) was used to build the computational grid for FASTMECH. The MD_SWMS also was used to edit model input, run the model, and view model simulation results. The computational grid was 27,730-ft long with 3,371 nodes in the streamwise direction and 1,148.3-ft wide with 141 nodes in the cross-stream direction, forming an approximately 2.5×2.5 m grid. The computational grid included 475,311 nodes.

Calibration of the FASTMECH model included five historical discharge conditions ranging from 10,500 to 28,900 ft^3/s. Only drag coefficients were adjusted during calibration. Water-surface elevations at the downstream boundary were based on results from the HEC-6 model in fixed-bed mode. Results from FASTMECH were compared to results from HEC-6, used instead of measured data. Differences in water-surface elevation between FASTMECH and HEC-6 were less than 0.15 ft, except for one value at 0.18 ft. The mean absolute difference error and maximum difference in water-surface elevation also were less than ±0.15 ft except for one value.

Results from the calibration simulations of FASTMECH also included simulated depth and velocity. The model showed that flow depths increased as river discharges increased, except for the fourth simulation where high lake elevations cause water-surface elevations in the river to be high due to backwater conditions. The water-surface elevation at the downstream boundary in simulation 4 was about 2 ft higher than in simulation 5. However, the river discharge for simulation 5 was about 6,000 ft^3/s greater than for simulation 4. The reach from RM 157.0 to RM 157.7 was the shallowest in all simulations. In the dredged reach, average simulated depth ranged from 21 to 31 ft. Simulated velocities also increased as river discharges increased. Average simulated velocities along the thalweg ranged from about 3 to 5.3 ft/s, and maximum simulated velocities ranged from 3.9 to about 7 ft/s. In the dredged reach, average simulated velocities along the thalweg ranged from 3.5 to 6 ft/s.

The FASTMECH model also showed several areas where reverse flows (back-eddies) occurred. These back-eddies usually occurred near river bends. A large back-eddy near the left bank near RM 158.3 was about 120 ft in width and about 500 ft in length and encompassed about one-third of the river width. Other back-eddies occurred throughout the modeled reach but were much smaller. No back-eddies occurred in the dredged reach.

FASTMECH also simulated bed shear stress. Simulations showed that as river discharge increased, bed shear stress increased. Average stress along the thalweg increased more than 200 percent from simulation 1 (river discharge of 10,500 ft^3/s) to simulation 5 (river discharge of 28,900 ft^3/s). Bed shear stress was used to assess sediment mobility potential. The potential of sediment mobility occurs when the bed shear stress exceeds the critical shear stress of the particle. This only determines whether a given particle is potentially mobile. Simulated sediment mobility indicated the transport of very coarse sand to fine gravel in these simulations. In simulation 5, simulated sediment mobility potential indicated the transport of very fine gravel to fine gravel. Also these simulations showed areas of greater sediment mobility potential near the thalweg where bed shear stresses were greater. Areas of lower sediment mobility potential were near the banks and back-eddies where bed shear stress was lower.

The models developed and calibrated for this study closely duplicate measured water-surface elevations and sediment discharges. Because the FASTMECH model was calibrated only to water-surface elevations from the HEC-6 model, a better understanding of flow and hydraulics in this reach would improve the model if water-surface elevations were measured at different flows. Greater understanding and improvement to the model would also occur if cross-stream and longitudinal velocities were measured throughout the study reach at different flows. The FASTMECH model is limited to river discharges contained within the river banks. Flood flows that overtop the banks and spread onto the floodplain would have to be addressed by a multi-dimensional floodplain model with sediment transport capability.

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Glossary

armor layer A coarser surficial layer of sediments on the streambed. This layer ranges from one particle thickness to several. This layer can be quite resistant to scour—usually only high flows mobilize this layer and it may re-form as flows decrease.

backwater Water backed up or retarded in its course as compared with its normal or free-flowing condition. Backwater is an increase in upstream flow depth due to a dam, constriction in a channel, change in channel slope, or change in roughness. Backwater is denoted by hydraulic engineers as an M_1 curve.

bedform Alluvial-channel bottom feature that depends on bed-material size, flow depth, and flow velocity. Bedforms include ripples, dunes, antidunes, and plane bed.

boundary or bed shear stress Stress that acts in the direction of flow on the streambed. Bed shear stress is often related to the ability of flow to move sediment on the streambed.

channel The channel includes the thalweg and streambed.

confluence The flowing together of two or more streams; the place where a tributary joins the main stream.

conveyance A measure of the carrying capacity of a channel section and is directly proportional to channel discharge. Conveyance is that part of Manning's equation that excludes the square root of the energy gradient or friction slope.

critical flow The depth at which flow is at its minimum energy. Inertial forces equal gravitational forces.

cross section A series of coordinate pairs of elevation and stationing that describes the channel shape perpendicular to the mean flow direction.

flood Any relatively high streamflow that overtops the natural or artificial banks of a river.

floodplain Land adjoining (or near) the channel of a watercourse that is usually dry, but has been, or may be, covered by floodwaters. A floodplain functions as a temporary channel or reservoir for overbank flows.

free-flowing water Water that is not backed up or retarded in its course. Free-flowing water is denoted by hydraulic engineers as an M_2 or M_3 curve.

high-water marks Evidence of the stage reached by a flow. High-water marks generally consist of debris, scour marks, or staining of rocks along the channel banks.

hydrograph A graph of stage or discharge versus time.

Manning's roughness coefficient (*n*-values) or Manning's *n* A measure of the frictional resistance exerted by a channel on the flow. The *n* value also can reflect other energy losses such as those resulting from the transport of material and debris, unsteady flow, extreme turbulence, that are difficult or impossible to isolate and quantify.

normal depth The depth of flow for a given discharge, fixed channel shape, slope, and roughness.

particle-size The size of material on the bed of a stream, referenced to a specific diameter (either maximum, intermediate, or minimum) of the measured particle.

peak flow See runoff peak flow.

reach A length of stream that is selected to represent a uniform set of physical, chemical, and biological conditions.

river bank The sloping ground that borders a stream and confines the water in the channel. A river bank is bordered by the floodplain and channel.

runoff peak flow The largest value of the runoff flow, that occurs during a flood, as measured at a particular point in the drainage basin.

slope The change in elevation per unit change in the channel's length.

stage The height of a water surface above gage datum; same as gage height.

stage-discharge relation The relation between the water-surface elevation and discharge.

steady flow Discharge and depth of flow does not change with time or during a selected period of time.

streamflow, discharge, or flow A general term for water flowing through a channel.

subcritical flow If the flow is subcritical, flow depth is greater than the flow depth in critical flow. Inertial forces are less than the gravitational forces.

thalweg A line connecting the lowest points along the length of a riverbed. It can be quite sinuous and wander within the channel.

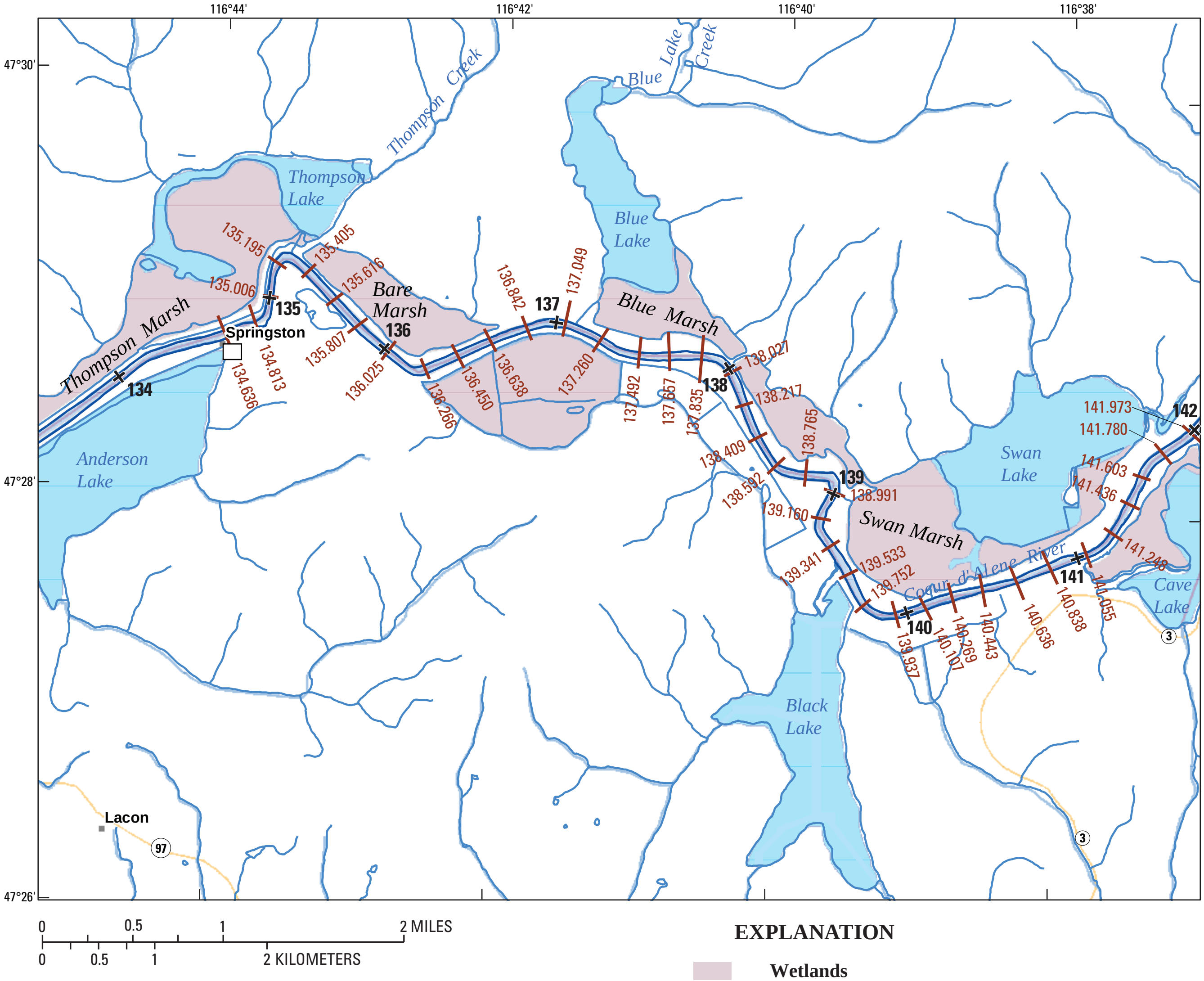
transient flow Discharge and depth of flow changes with time.

water-surface curves or profile Longitudinal plots of the water-surface elevation as a function of distance downstream through a channel reach.

water-surface elevation Height of a water surface above a datum; same as adding stage and NAVD 88 datum for example.

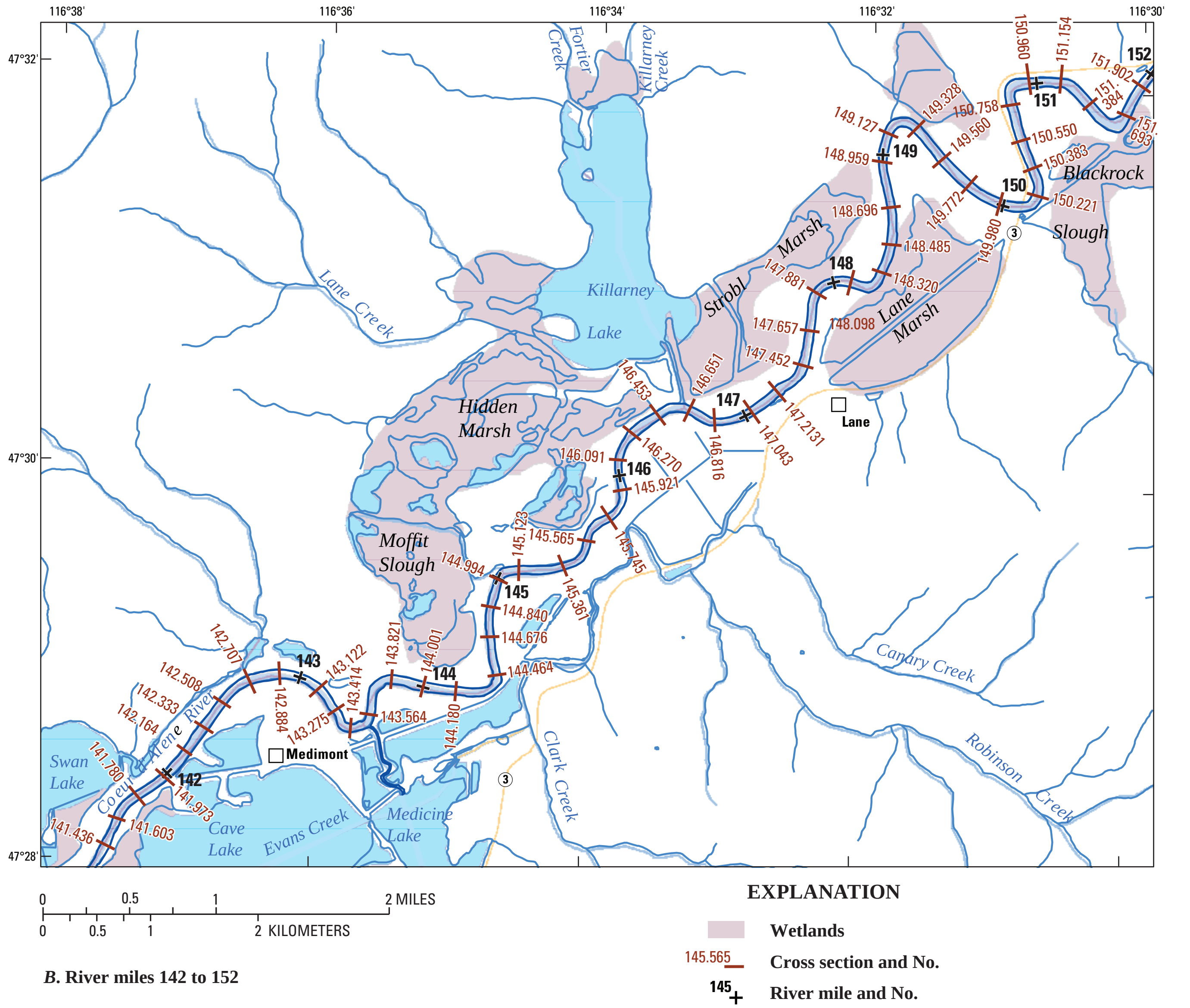
velocity-stage-discharge relation Relation between velocity, water-surface elevation, and discharge.

Appendix A. Locations of Cross Sections on the Coeur d' Alene River, Idaho



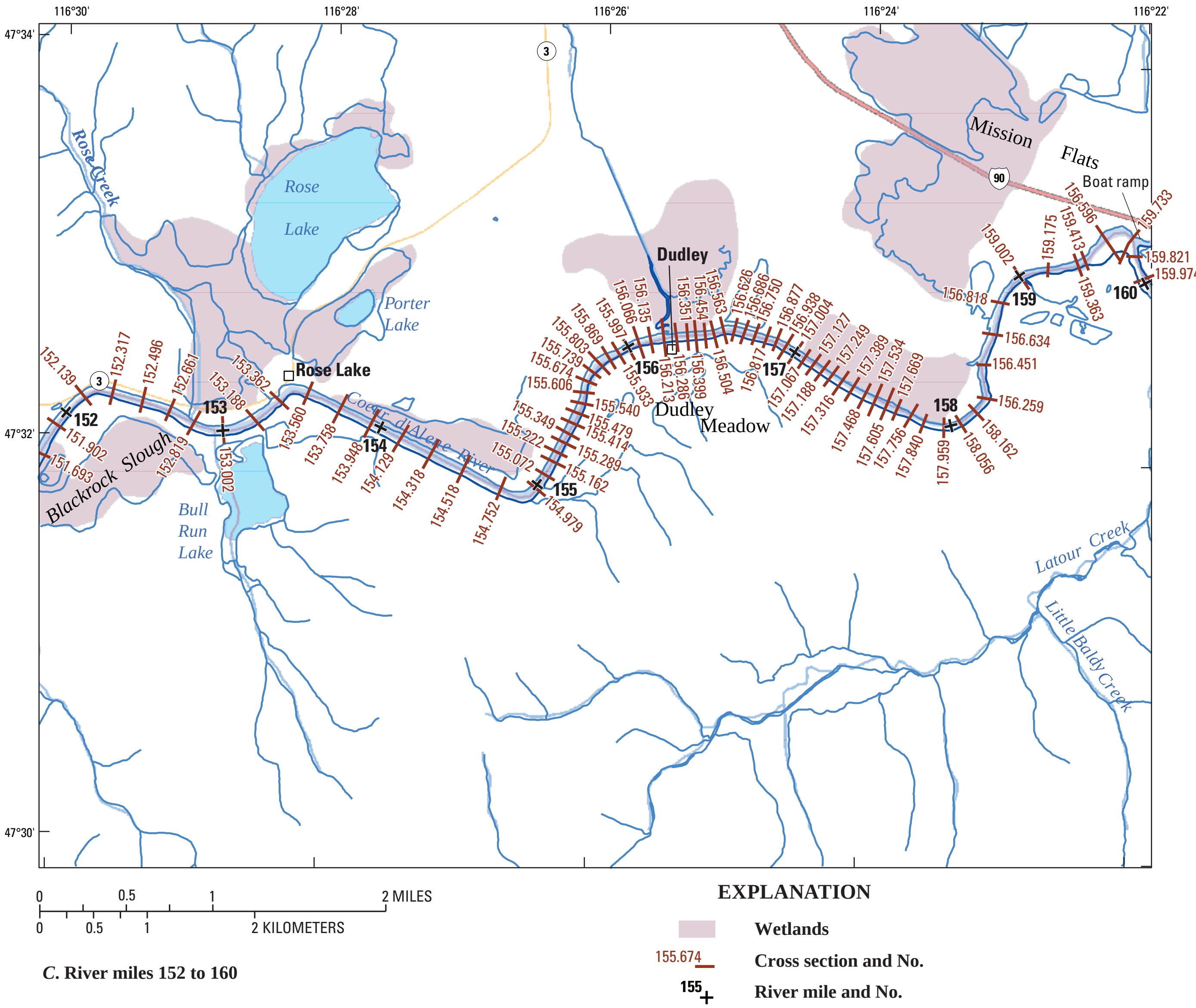
A. **River miles 134 to 142**

Figure A1. Location of stream channel cross sections used for the 1-dimensional sediment-transport model (HEC-6) and river miles on the Coeur d'Alene River, Idaho.



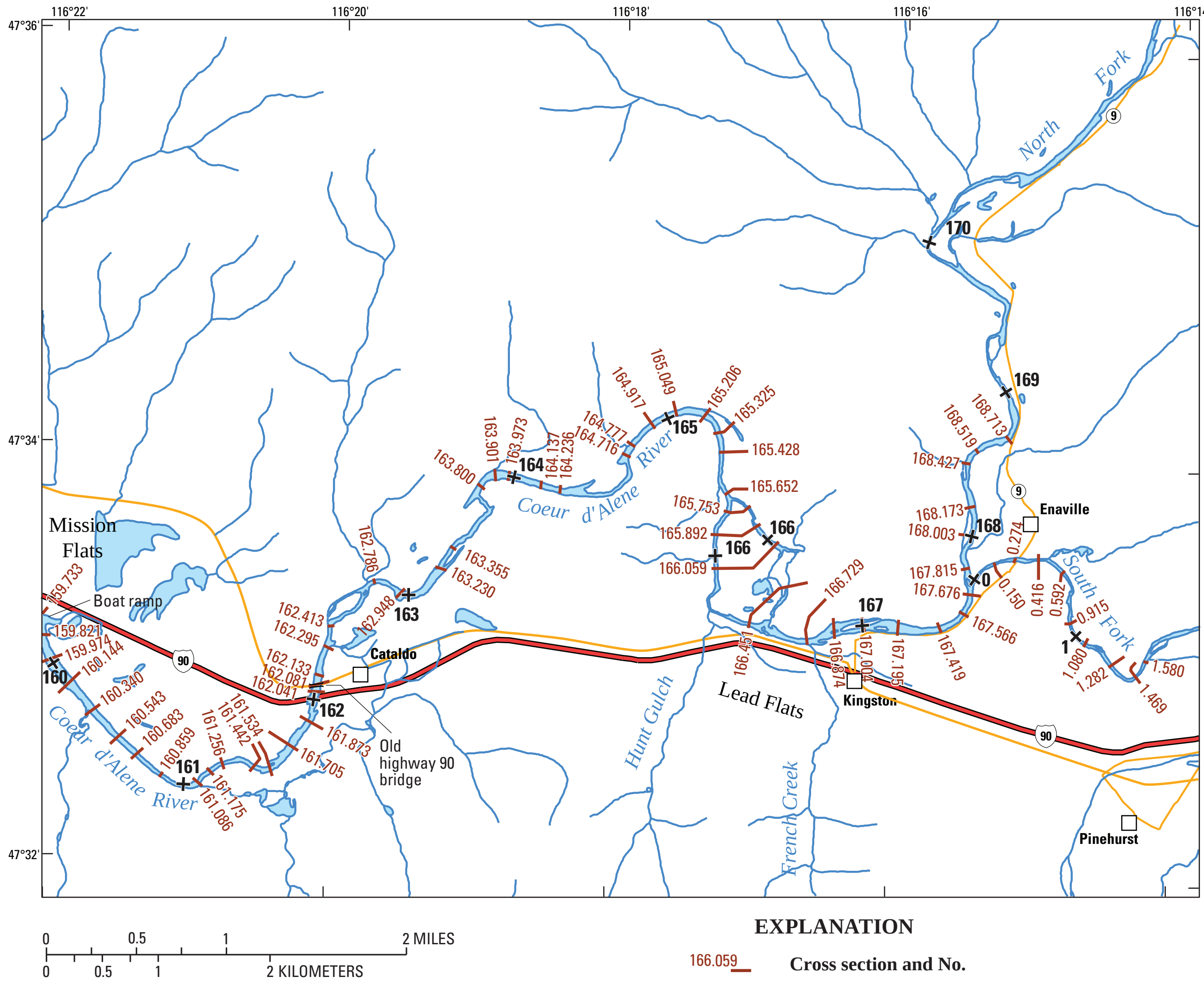
***B*. River miles 142 to 152**

Figure A1.—Continued



C. **River miles 152 to 160**

Figure A1.—Continued



***D*. River miles 160 to 170 and 0 to about 2 on the South Fork Coeur d'Alene River**

Figure A1.—Continued

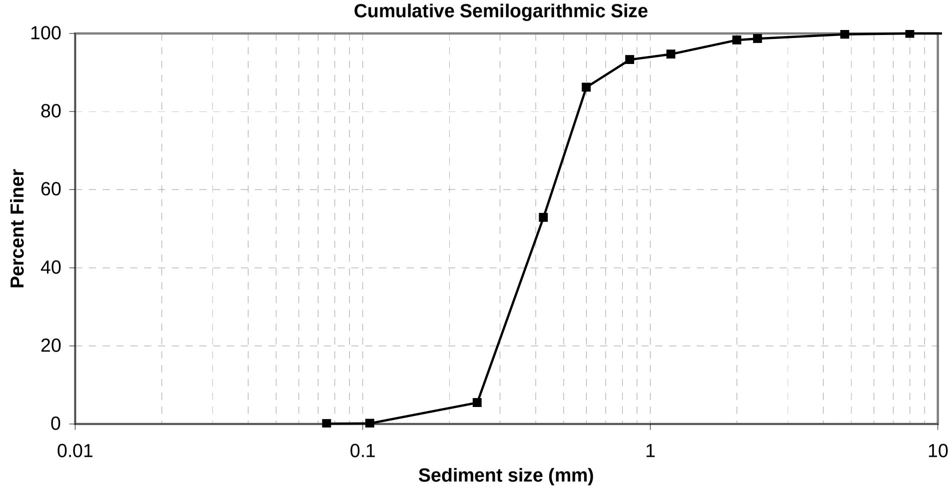
Appendix B. Particle-Size Analysis of Streambed Samples in the Dudley Reach, Coeur d'Alene River, Idaho

SIEVE ANALYSIS

Sample ID:	D1 (Cross Section 157.067)
Location:	Coeur d'Alene River near Dudley
Date/Time:	5/4/05 @ 1354
Analyzed by:	Andy Tranmer
Date/Time:	June 14, 2005
Gross weight:	2319.8 g
Tare weight:	829.4 g
Net weight:	1490.4 g
Gravel weight:	79.1 g
Sand weight:	1410.0 g
Portion analyzed:	14690.4 g
Remarks:	Ponar dredge sample collected by Russ Christensen and John Gralow. Some larger particles with woody debris

Sieve Size (mm)	Weight (g)	Percent Finer	Cumulative Percent Finer	Size Class	Remarks
		0.00	100.00		
		0.00	100.00		
		0.00	100.00		
512		0.00	100.00	Boulders	
256		0.00	100.00	Cobble	
128		0.00	100.00		
64		0.00	100.00		
32		0.00	100.00		
16		0.00	100.00	gravel	
8		0.00	100.00		
4.75	3.7	0.25	99.75		
2.36	16.1	1.08	98.67	Very coarse sand	
2	5.6	0.38	98.29		
1.18	53.7	3.60	94.69	Granule	
0.85	20.8	1.40	93.29		
0.6	105.8	7.10	86.20	Coarse sand	
0.425	496.8	33.33	52.87	Medium sand	
0.25	707.3	47.44	5.43	Fine sand	
0.106	78.4	5.26	0.16	Very fine sand	
0.075	0.9	0.06	0.10		
<0.075	1.5	0.10	0.00	Silt & clays	
TOTAL	1490.7				

Cumulative Semilogarithmic Size



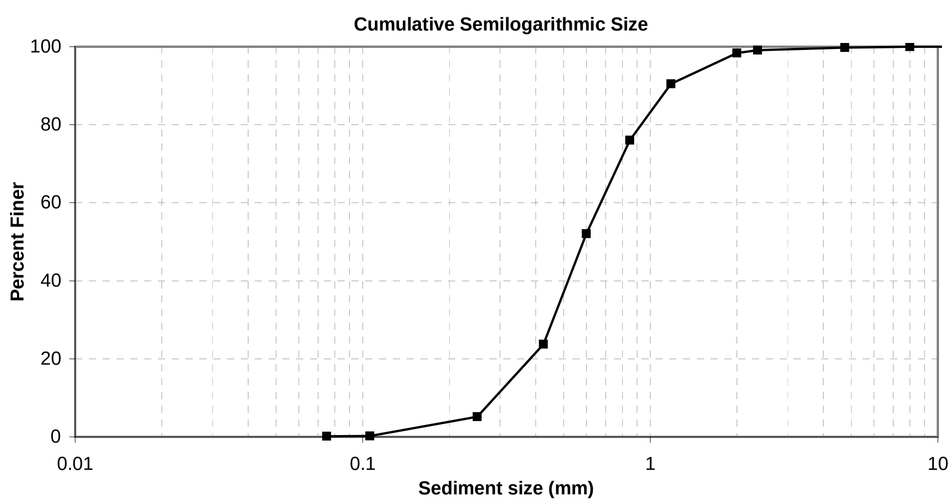
Particle Characteristics			
d_{90}	=	0.72	mm
$d_{84.1}$	=	0.59	mm
d_{65}	=	0.48	mm
d_{50}	=	0.41	mm
d_{35}	=	0.35	mm
$d_{15.9}$	=	0.28	mm
d_g	=	0.41	mm
σ_g	=	1.45	mm
G	=	0.85	

Sample D1

SIEVE ANALYSIS

Sample ID:	D2 (Cross Section 156.686)
Location:	Coeur d'Alene River near Dudley
Date/Time:	5/4/05 @ 1412
Analyzed by:	Andy Tranmer
Date/Time:	June 14, 2005
Gross weight:	1987.9 g
Tare weight:	327.9 g
Net weight:	1660.1 g
Gravel weight:	158.5 g
Sand weight:	1500.0 g
Portion analyzed:	1660.1 g
Remarks:	Ponar dredge sample collected by Russ Christensen and John Gralow. Some larger particles with woody debris Insect larval casing

Sieve Size (mm)	Weight (g)	Percent Finer	Cumulative Percent Finer	Size Class	Remarks
		0.00	100.00		
		0.00	100.00		
		0.00	100.00		
512		0.00	100.00	**Boulders**	
256		0.00	100.00	**Cobble**	
128		0.00	100.00		
64		0.00	100.00		
32		0.00	100.00		
16		0.00	100.00	**gravel**	
8		0.00	100.00		
4.75	3.8	0.23	99.77		
2.36	11.5	0.69	99.08	**Very coarse sand**	
2	11.4	0.69	98.39		
1.18	131.8	7.93	90.46	**Granule**	
0.85	239.1	14.39	76.06		
0.6	398.6	24.00	52.06	**Coarse sand**	
0.425	470.2	28.31	23.75	**Medium sand**	
0.25	308.8	18.60	5.15	**Fine sand**	
0.106	81.4	4.90	0.25	**Very fine sand**	
0.075	1.9	0.11	0.13		
<0.075	2.2	0.13	0.00	**Silt & clays**	
TOTAL	1660.7				



Particle Characteristics

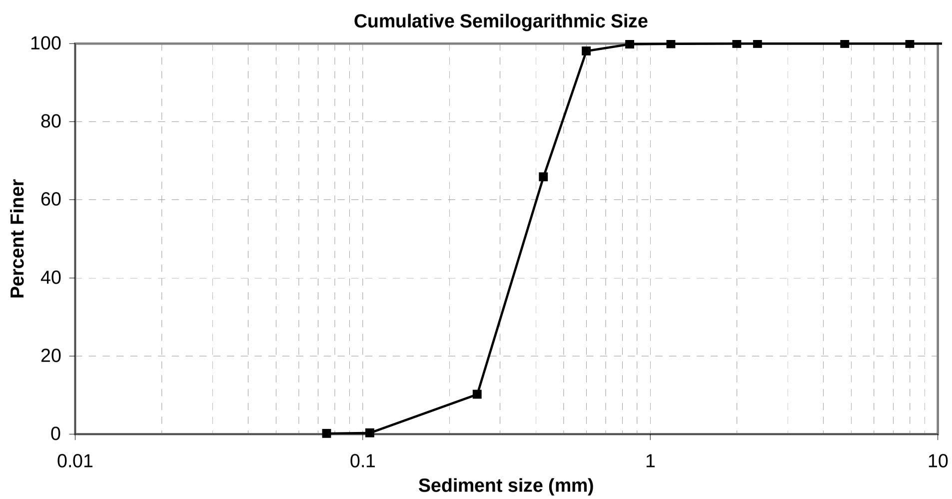
d_{90}	=	1.17	mm
$d_{84.1}$	=	1.02	mm
d_{65}	=	0.72	mm
d_{50}	=	0.59	mm
d_{35}	=	0.49	mm
$d_{15.9}$	=	0.34	mm
d_g	=	0.59	mm
σ_g	=	1.73	mm
G	=	0.93	

Sample D2

SIEVE ANALYSIS

Sample ID:	D3 (Cross Section 156.213)
Location:	Coeur d'Alene River near Dudley
Date/Time:	5/4/05 @ 1328
Analyzed by:	Andy Tranmer
Date/Time:	June 15, 2005
Gross weight:	1700.7 g
Tare weight:	378.9 g
Net weight:	1321.8 g
Gravel weight:	0.6 g
Sand weight:	1319.3 g
Portion analyzed:	1321.8 g
Remarks:	Ponar dredge sample collected by Russ Christensen and John Gralow. Fairly uniform sand particles

Sieve Size (mm)	Weight (g)	Percent Finer	Cumulative Percent Finer	Size Class	Remarks
		0.00	100.00		
		0.00	100.00		
		0.00	100.00		
512		0.00	100.00	Boulders	
256		0.00	100.00	Cobble	
128		0.00	100.00		
64		0.00	100.00		
32		0.00	100.00		
16		0.00	100.00	gravel	
8		0.00	100.00		
4.75	0.0	0.00	100.00		
2.36	0.1	0.01	99.99	Very coarse sand	
2	0.1	0.01	99.99		
1.18	0.4	0.03	99.96	Granule	
0.85	1.3	0.09	99.86		
0.6	23.2	1.76	98.10	Coarse sand	
0.425	426.7	32.28	65.82	Medium sand	
0.25	735.4	55.63	10.19	Fine sand	
0.106	130.5	9.87	0.32	Very fine sand	
0.075	2.3	0.17	0.15		
<0.075	1.9	0.15	0.00	Silt & clays	
TOTAL	1321.8				



Particle Characteristics

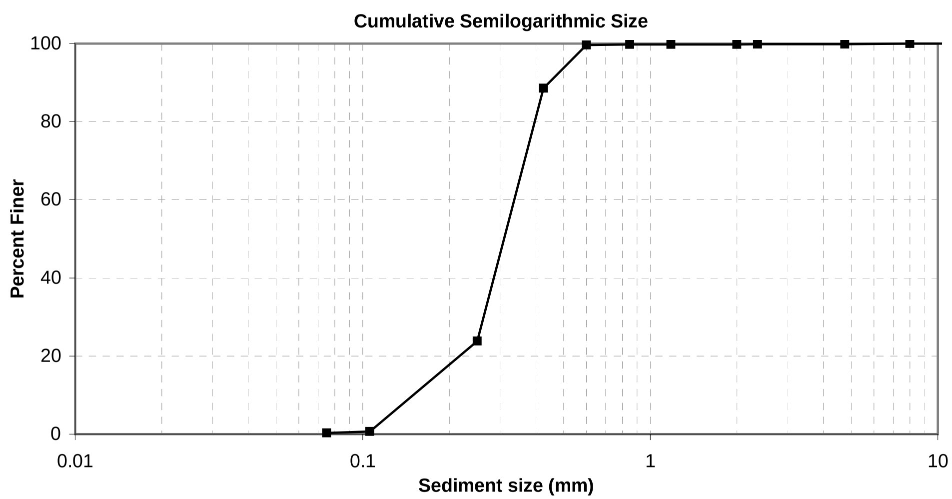
d_{90}	=	0.55	mm
$d_{84.1}$	=	0.52	mm
d_{65}	=	0.42	mm
d_{50}	=	0.37	mm
d_{35}	=	0.32	mm
$d_{15.9}$	=	0.26	mm
d_g	=	0.37	mm
σ_g	=	1.41	mm
G	=	0.84	

Sample D3

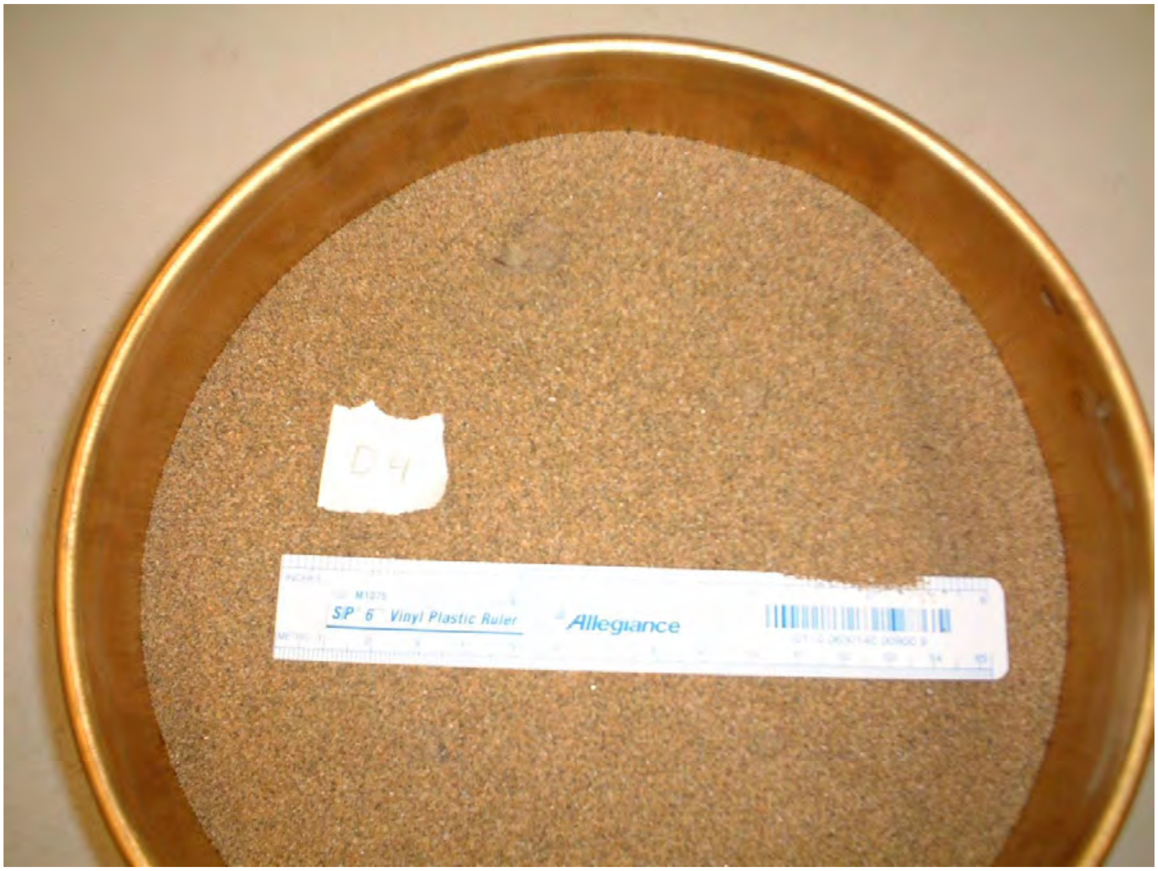
SIEVE ANALYSIS

Sample ID:	D4 (Cross Section 155.739)
Location:	Coeur d'Alene River near Dudley
Date/Time:	5/4/05 @ 1216
Analyzed by:	Andy Tranmer
Date/Time:	June 15, 2005
Gross weight:	1095.3 g
Tare weight:	376.4 g
Net weight:	719.0 g
Gravel weight:	1.5 g
Sand weight:	715.4 g
Portion analyzed:	1465.4 g
Remarks:	Ponar dredge sample collected by Russ Christensen and John Gralow. Some larger particles with woody debris

Sieve Size (mm)	Weight (g)	Percent Finer	Cumulative Percent Finer	Size Class	Remarks
		0.00	100.00	Boulders	
		0.00	100.00		
		0.00	100.00		
512		0.00	100.00		
256		0.00	100.00	Cobble	
128		0.00	100.00		
64		0.00	100.00	gravel	
32		0.00	100.00		
16		0.00	100.00		
8		0.00	100.00		
4.75	0.9	0.13	99.87		
2.36	0.3	0.04	99.83	Very coarse sand	
2	0.1	0.02	99.81		
1.18	0.1	0.02	99.80	Granule	
0.85	0.1	0.01	99.78	Coarse sand	
0.6	0.9	0.12	99.66		
0.425	79.6	11.08	88.59	Medium sand	
0.25	465.6	64.77	23.82	Fine sand	
0.106	166.2	23.13	0.69	Very fine sand	
0.075	2.9	0.41	0.28	Silt & clays	
<0.075	2.0	0.28	0.00		
TOTAL	718.9				



Particle Characteristics			
d_{90}	=	0.44	mm
$d_{84.1}$	=	0.41	mm
d_{65}	=	0.35	mm
d_{50}	=	0.31	mm
d_{35}	=	0.27	mm
$d_{15.9}$	=	0.19	mm
d_g	=	0.28	mm
σ_g	=	1.47	mm
G	=	0.86	



Sample D4

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Appendix C. Listing of HEC-6 Model Input File for 1999

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T1 Coeur d'Alene River
T2 Simulation--Calendar Year 1999
T3 Main Stem, North Fork,& South Fork

   ***MAIN STEM***
   ***Start of sandbed reach***

   CROSS SECTION #RM134.636         HARRISON GAGING STATION
NC .0291   .0291   .0331      .1      .3
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X134.636      50     389   738.8       0       0       0
GR  2138   334.9  2137.6     336  2136.9   361.7  2137.1   361.8  2137.1     389
GR2123.1   449.5  2120.9   454.1  2119.5   455.6  2108.3   477.6    2108   478.9
GR2107.4   478.9  2107.1   480.6  2105.7   484.8  2104.9   492.1  2104.5     501
GR2103.2   508.3  2104.6   517.2  2104.2   527.5  2103.5   531.9  2102.6   534.8
GR2097.7     545  2096.3   552.2  2096.3   556.9  2097.8   565.6  2101.8   593.5
GR  2102   595.2  2104.9   621.4  2106.4   641.9  2106.8   652.3  2105.8   662.4
GR2110.1     677  2113.9   685.8  2121.2   699.2  2134.2   738.8  2133.9   740.1
GR2134.3   740.5  2132.4   767.4  2132.8   767.8  2133.2   777.3  2132.5     778
GR  2133   778.6  2132.6   779.5  2134.4   788.1  2133.9   788.8    2134   799.2
GR2133.2   801.6  2135.8     810  2135.9   812.4  2137.6   819.7  2137.5   831.4
HD34.636      30   477.6   677.0

   CROSS SECTION #RM134.813
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X134.813      50   492.2   806.4   942.9   942.9   942.9
GR2138.1   464.9  2137.8   471.8  2137.2   472.2  2134.1   481.8  2134.6   483.1
GR2134.6   492.2  2134.1     495  2122.8   515.2    2123   516.5  2120.1   519.8
GR  2117   524.1  2111.9   537.1  2105.2     549  2100.2   561.9  2096.4   572.5
GR2088.7   603.1  2084.5   616.8  2082.9   625.2    2083   631.1  2084.2   648.9
GR2087.6   669.3  2089.3     684    2090   688.4  2091.7   694.4  2093.9   700.3
GR2099.1   711.6  2106.5   725.5  2106.4   726.3  2108.1   728.3  2113.4     740
GR2111.7   740.9  2114.1   741.3    2118   748.7  2116.2   751.5  2120.3   751.7
GR  2119   754.3  2120.6   754.8  2134.2   797.3  2135.3   806.4  2134.9   808.2
GR2133.8     834  2132.9   898.6  2135.6   908.2  2135.3   919.9  2136.1   924.3
GR  2134     944  2134.9   950.5    2133   953.3  2137.1   961.1  2137.6   973.3
HD34.813      30   537.1   740.0

   CROSS SECTION #RM135.006
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.006      50    60.7   388.8  1027.1  1027.1  1027.1
GR2137.1    60.7    2137    63.8  2132.9    79.3  2123.5    99.4  2121.9    99.7
GR  2122   102.7  2121.4   102.8  2119.8   106.3  2115.2   112.8  2115.8   113.2
GR2113.6   116.1  2114.3   116.3  2112.2   119.4  2112.5   119.6  2106.8   129.3
GR  2101   142.4  2096.5   155.6  2094.5   165.3  2094.6   165.4    2094   171.9
GR2094.5   172.1  2094.4     175  2094.8   175.4  2094.6   178.5  2094.8   184.9
GR2094.4   194.8  2095.3   204.6  2096.6   214.3  2097.4   214.6  2099.9   227.9
GR  2101   230.9  2105.9   240.5  2105.7   240.8  2108.1   247.6  2109.1   254.2
GR2112.4   263.7    2112   263.8  2113.1   266.8  2112.4     267  2112.8   277.1
GR2112.4   277.2  2116.1     290  2120.4   299.9  2120.9     300  2130.9   354.1
GR2130.5   387.3  2131.7   388.8  2132.4   414.6  2131.6   468.7  2132.2   480.3
```

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T1 Coeur d'Alene River
T2 Simulation--Calendar Year 1999
T3 Main Stem, North Fork,& South Fork

   ***MAIN STEM***
   ***Start of sandbed reach***

   CROSS SECTION #RM134.636         HARRISON GAGING STATION
NC .0291   .0291   .0331      .1      .3
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X134.636      50     389   738.8       0       0       0
GR  2138   334.9  2137.6     336  2136.9   361.7  2137.1   361.8  2137.1     389
GR2123.1   449.5  2120.9   454.1  2119.5   455.6  2108.3   477.6    2108   478.9
GR2107.4   478.9  2107.1   480.6  2105.7   484.8  2104.9   492.1  2104.5     501
GR2103.2   508.3  2104.6   517.2  2104.2   527.5  2103.5   531.9  2102.6   534.8
GR2097.7     545  2096.3   552.2  2096.3   556.9  2097.8   565.6  2101.8   593.5
GR  2102   595.2  2104.9   621.4  2106.4   641.9  2106.8   652.3  2105.8   662.4
GR2110.1     677  2113.9   685.8  2121.2   699.2  2134.2   738.8  2133.9   740.1
GR2134.3   740.5  2132.4   767.4  2132.8   767.8  2133.2   777.3  2132.5     778
GR  2133   778.6  2132.6   779.5  2134.4   788.1  2133.9   788.8    2134   799.2
GR2133.2   801.6  2135.8     810  2135.9   812.4  2137.6   819.7  2137.5   831.4
HD34.636      30   477.6   677.0

   CROSS SECTION #RM134.813
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X134.813      50   492.2   806.4   942.9   942.9   942.9
GR2138.1   464.9  2137.8   471.8  2137.2   472.2  2134.1   481.8  2134.6   483.1
GR2134.6   492.2  2134.1     495  2122.8   515.2    2123   516.5  2120.1   519.8
GR  2117   524.1  2111.9   537.1  2105.2     549  2100.2   561.9  2096.4   572.5
GR2088.7   603.1  2084.5   616.8  2082.9   625.2    2083   631.1  2084.2   648.9
GR2087.6   669.3  2089.3     684    2090   688.4  2091.7   694.4  2093.9   700.3
GR2099.1   711.6  2106.5   725.5  2106.4   726.3  2108.1   728.3  2113.4     740
GR2111.7   740.9  2114.1   741.3    2118   748.7  2116.2   751.5  2120.3   751.7
GR  2119   754.3  2120.6   754.8  2134.2   797.3  2135.3   806.4  2134.9   808.2
GR2133.8     834  2132.9   898.6  2135.6   908.2  2135.3   919.9  2136.1   924.3
GR  2134     944  2134.9   950.5    2133   953.3  2137.1   961.1  2137.6   973.3
HD34.813      30   537.1   740.0

   CROSS SECTION #RM135.006
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.006      50    60.7   388.8  1027.1  1027.1  1027.1
GR2137.1    60.7    2137    63.8  2132.9    79.3  2123.5    99.4  2121.9    99.7
GR  2122   102.7  2121.4   102.8  2119.8   106.3  2115.2   112.8  2115.8   113.2
GR2113.6   116.1  2114.3   116.3  2112.2   119.4  2112.5   119.6  2106.8   129.3
GR  2101   142.4  2096.5   155.6  2094.5   165.3  2094.6   165.4    2094   171.9
GR2094.5   172.1  2094.4     175  2094.8   175.4  2094.6   178.5  2094.8   184.9
GR2094.4   194.8  2095.3   204.6  2096.6   214.3  2097.4   214.6  2099.9   227.9
GR  2101   230.9  2105.9   240.5  2105.7   240.8  2108.1   247.6  2109.1   254.2
GR2112.4   263.7    2112   263.8  2113.1   266.8  2112.4     267  2112.8   277.1
GR2112.4   277.2  2116.1     290  2120.4   299.9  2120.9     300  2130.9   354.1
GR2130.5   387.3  2131.7   388.8  2132.4   414.6  2131.6   468.7  2132.2   480.3
```

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HD35.006      30   102.8   299.9
```

CROSS SECTION #RM135.195

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.195      50   146.3   452.7   890.6   890.6   890.6
GR2133.7   146.3  2122.4   208.1  2120.3   212.5  2110.9   228.9  2109.5   229.3
GR2109.1   231.8  2107.8   232.2  2107.5   233.4  2101.4   243.5  2100.8   243.7
GR2099.8   246.3  2094.2   256.8    2090     267  2087.9   274.4  2086.8   274.7
GR2087.9   275.6    2087   275.9  2084.7   286.2  2082.4   297.9  2081.7   315.8
GR2083.4   316.9    2082   317.2  2083.8   321.3  2082.8   321.7  2083.8   322.9
GR2082.8   323.2  2084.2   324.3  2083.7   324.4  2085.3   336.1  2088.8   348.1
GR2092.2   357.9    2097   368.4  2100.1   380.3  2104.7   392.1  2112.1   403.6
GR2113.3   406.5  2113.7   406.8  2119.8   419.7  2118.9   420.1  2120.6   422.6
GR2133.4   452.7  2132.4   456.8  2132.6     460  2130.3     464  2128.1   471.2
GR2129.9   476.2  2128.7   476.6  2127.8   476.7  2135.1   484.1    2136   536.5
HD35.195      30   212.5   419.7
```

CROSS SECTION #RM135.405

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.405      80     117   480.4  1119.3  1119.3  1119.3
GR2130.7       0  2130.9     3.3  2130.1    10.6  2130.6    15.6  2130.5    28.8
GR2130.7    33.9    2131    36.6  2130.7    40.4  2132.7   102.3  2132.9     117
GR  2132     129  2132.2   131.9  2123.2   161.2  2122.5   161.5  2122.3   163.4
GR2122.1   163.7  2121.2   163.7  2120.9   165.8  2120.1   167.9  2119.7   168.4
GR2119.3   168.5  2117.6   172.9    2117   173.2  2117.2   175.1  2116.8   175.3
GR2115.5   180.1    2115   180.3  2113.3     187  2109.6   198.7  2108.7   207.9
GR2108.5   214.8  2107.2   223.7  2107.9   228.9  2107.5   230.6  2107.7   231.2
GR2106.1   235.7  2106.2   237.9  2105.9   238.1  2105.7   240.4  2106.1   242.6
GR2106.5   251.8  2106.5   256.6  2106.4   256.8    2106     266  2105.3   272.5
GR2104.6   282.1  2104.7   282.4    2104   286.8    2103   298.7  2102.2   309.5
GR2101.4   330.6  2100.8   338.3  2100.8   342.8  2101.8     347    2102   347.2
GR2102.7   349.1  2104.1   351.5  2104.2     352  2108.1   361.3  2108.4   361.3
GR  2109   363.4  2109.4   363.7  2111.8   368.2  2112.4   370.2    2113   370.8
GR2113.6   372.6  2114.1   372.9  2114.4   373.2  2114.5   374.8  2114.9     375
GR2115.4   375.4  2115.7   377.2  2116.2   377.4  2116.6   377.8  2132.4   480.4
GR2129.7   520.6  2129.3   529.5  2129.5   529.6  2129.9   530.2  2128.9   567.5
HD35.405      30   172.9   377.8
```

CROSS SECTION #RM135.616

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.616      80     143   469.4  1127.8  1127.8  1127.8
GR2129.5       0  2129.8     3.6  2129.8    12.6  2133.2     143    2131   175.1
GR2129.3   177.7  2128.4   185.2  2117.5   193.9  2115.2   198.6  2112.7   205.7
GR2111.5   210.1  2110.8   212.2  2108.8   219.2    2109   219.7  2108.3   221.6
GR2108.5   222.1  2107.7   223.8  2107.9   224.3  2105.9   231.1  2104.9   240.6
GR2104.7     245  2105.2   252.1  2105.8   256.7  2106.2   261.4  2105.5   277.4
GR2105.1   279.5  2105.4   279.8  2105.1   281.9  2105.4   282.2  2105.3   286.5
GR2105.5   286.5  2105.7     287  2105.7     296  2105.4   300.9  2105.4   310.1
GR2105.2   314.7  2105.4   324.2  2105.6   325.9  2105.9   333.3  2106.3   347.5
GR  2106   349.1  2106.2   349.3  2105.7     366  2105.5     368  2105.2     375
GR2105.2     382  2105.3   382.3  2104.9   384.1  2105.2   384.4    2105   388.7
GR2105.2     389  2105.9   393.5    2109   400.9  2111.6     405  2111.5   405.3
GR2111.8   405.3  2112.9   407.5  2114.4   409.7    2117   414.5  2117.5   414.8
GR2118.4   416.7  2118.7   416.8  2119.2   418.9  2120.8   421.3  2121.6   423.5
```

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GR  2122     426  2123.4   428.1    2124   428.3  2128.9   432.7    2130   441.5
GR2130.5   448.3  2133.5   469.4  2132.6   511.5  2134.4     544  2134.9   545.4
GR2134.5   555.9  2133.2   577.3  2133.6   578.8  2133.8   590.7  2134.3   594.9
HD35.616      30   205.7   409.7
```

CROSS SECTION #RM135.807

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X135.807      50   181.8   527.2  1017.3  1017.3  1017.3
GR2138.7    64.3  2137.5    75.9  2134.8    76.9    2132    90.4  2131.6    90.8
GR2132.1    98.6  2131.3   106.7  2137.6   181.8  2124.7   233.7  2125.4     234
GR2124.2   236.4    2124   238.4  2114.8   254.8  2112.2   261.8  2112.5   262.1
GR2105.4   280.4  2101.9   305.8  2102.4     306  2101.3     318  2101.8   319.8
GR2102.3     334  2101.5   336.1  2102.2   336.4  2102.7   357.2  2103.2   357.5
GR2102.5   359.4  2102.9   359.7  2102.8     364  2103.4   364.2  2103.4   368.3
GR2104.4   371.3  2105.8   384.9  2106.1   394.2  2107.1   401.1  2108.1   415.1
GR2108.3   431.8    2108   450.3    2107     466  2107.2   473.5  2109.4   480.4
GR2108.9   480.6  2111.1   482.3  2110.3   482.7  2111.9   484.8  2116.5   491.8
GR2116.1   491.9  2121.9   498.4  2121.2   498.7  2132.7   527.2  2134.6   644.2
HD35.807      30   261.8   484.8
```

CROSS SECTION #RM136.025

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X136.025      50   253.9   593.4  1172.5  1172.5  1172.5
GR  2139     243  2138.5   243.1  2138.1   253.9  2134.7   263.4  2132.4   266.7
GR2131.3   268.8  2131.7     269  2131.1   269.9  2121.2   279.4    2121   280.5
GR2108.1   297.5  2105.1   303.1  2103.8   307.7  2102.8   313.2    2103   313.9
GR  2102   317.6  2100.3   325.6    2101   326.1  2100.8   326.6  2100.3   331.3
GR2100.1   336.9  2099.9   349.5    2100   350.4  2099.4   357.8  2100.1     365
GR2100.9     366  2099.6   366.8  2100.8   367.8  2099.1   368.4  2101.9   368.8
GR2100.1   369.6  2101.4     375  2100.6   395.9  2099.6   412.2  2099.7   419.6
GR2101.9   439.6  2102.5   457.8  2103.2   468.6    2105   480.5  2106.7   485.4
GR2109.3   494.2  2117.1   509.7  2118.8   512.5  2121.2   515.3  2122.1   515.9
GR2121.7   516.3  2122.8   518.1  2133.9   593.4    2134   600.4  2136.3   664.6
HD36.025      30   297.5   494.2
```

CROSS SECTION #RM136.226

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X136.226      80   172.7     484  1338.9  1338.9  1338.9
GR2138.3       0  2135.5    17.2  2135.1    28.1  2134.3    30.7  2131.4    58.1
GR2131.9    58.3  2130.9      69  2131.7    79.9  2132.1    80.3  2131.6    81.9
GR2132.1   128.1  2131.8   163.9  2132.2   172.2  2132.6   172.7  2126.4   199.8
GR2125.5   206.9  2125.6   208.7    2125   211.6  2124.5   212.9  2123.1   214.5
GR2123.1     216  2117.2     226  2116.6   227.8  2115.6   228.9  2114.8   230.7
GR  2113   233.6  2112.3   235.1  2111.3   236.5  2107.5   243.8  2105.1   249.8
GR  2105   251.1  2101.8     260  2101.6   261.3  2101.5   264.4  2101.7   267.3
GR2101.5   268.9  2101.7   270.2  2101.4   271.6  2101.4   276.2  2102.6   286.4
GR2102.3   290.9  2102.5   292.2  2102.5   295.3  2103.2   298.2  2103.2   308.4
GR2103.1   309.8  2103.5   312.9  2103.4   314.2  2104.1   315.7  2104.6   320.2
GR2104.8   327.5  2104.5     348  2105.1   359.7  2105.1   373.1  2105.3   377.3
GR2105.3   386.2  2105.8   393.5  2106.8   397.9  2106.8   403.9  2107.6   409.9
GR2108.1     411  2108.4   412.6  2112.1   427.3    2115   434.6  2120.4   443.5
GR2133.5   473.9  2134.4     484  2134.1   494.8  2134.1   502.6    2133   530.5
GR2133.1   545.9  2132.6   577.9    2133   581.6  2132.8   586.5  2132.2   592.1
GR2132.9   594.5  2132.7   613.8  2132.4     619  2132.6   644.6  2134.8   655.6
```

```
HD36.226      30   233.6   434.6
```

CROSS SECTION #RM136.450

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X136.450      80   184.1   433.1  1023.7  1023.7  1023.7
GR2134.6       0  2134.7     7.9  2135.2     8.3    2137    23.1  2136.9    30.2
GR2136.1    41.4  2137.4    42.1  2135.1    42.3  2137.4      43  2136.5    44.4
GR2136.3    53.7  2128.1    76.7  2127.8    78.9  2131.8   160.6  2131.7   184.1
GR  2116     210    2112   217.9  2111.6   218.3  2109.6   222.9  2108.5   226.4
GR2107.5     231  2106.8   235.5  2106.9   243.8  2106.4   248.4  2106.1   249.1
GR2106.4   252.8  2107.7   260.1  2107.5   260.8  2107.6   261.9  2105.3   273.7
GR2104.5   279.2  2104.5   283.8  2104.7   287.2  2105.6   289.5  2105.3     290
GR2105.9   295.7  2105.9   302.9  2105.5   308.6  2105.5     313  2105.3   323.1
GR2105.4     330  2104.1   348.5  2103.9     353  2103.9   361.9  2104.3   367.7
GR2104.2   368.4  2104.6   370.4  2104.3   371.1  2104.6     372  2104.4   372.7
GR2105.7   381.2  2106.1   382.2  2105.8   383.1  2106.7   384.9  2106.5   389.5
GR2105.9   393.2  2106.5   394.1  2106.3   394.8    2110   403.8  2115.4   410.4
GR2116.5   411.6  2117.9   412.2  2118.7   413.2  2119.7   413.8  2122.5   416.6
GR2122.8   417.7  2133.6   433.1  2133.9   475.7  2133.2   485.7  2133.9     494
GR2133.5   502.7  2133.2   540.9  2133.9   575.6  2136.6   591.7  2136.4   592.4
GR2134.6   592.4  2136.6   606.4  2135.3   606.6  2136.2   609.2  2134.7   619.1
HD36.450      30   210.0   410.4
```

CROSS SECTION #RM136.638

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X136.638      50   365.5   641.4  1045.5  1045.5  1045.5
GR2138.1   283.4    2129   329.7  2129.6   331.4  2130.1   365.5  2121.3     388
GR2110.5   409.2  2108.1   416.4  2107.3   419.9  2105.7   429.9  2104.8   437.9
GR2104.4     440    2104   447.4    2104   464.5  2103.5   471.7  2103.5   473.3
GR2102.9     480  2102.9   494.6  2102.6   495.5  2101.3   504.5  2101.6   517.2
GR2101.8   518.4  2101.8   530.9  2102.2   539.2  2102.1   542.7  2101.7   543.6
GR2100.1   550.1  2100.5   564.6  2100.9   567.4  2102.4   571.8    2105   576.4
GR2109.3   587.3  2116.6   599.5  2132.9     630  2133.6   641.4  2133.5   655.9
GR2132.6   669.8  2132.8   729.5    2132   770.9  2131.8   772.1  2132.8   781.3
GR2132.3   781.5  2132.3   783.4  2131.6   785.5  2133.7     788  2133.7   796.8
GR2131.5   801.6  2131.5   806.7  2132.9   807.9  2131.4   808.6  2133.1   809.3
HD36.638      30   409.2   587.3
```

CROSS SECTION #RM136.842

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X136.842      50   403.9   702.7  1136.6  1136.6  1136.6
GR2137.5   381.3  2137.5   385.9  2136.9   393.5    2137   403.9  2121.7   456.8
GR  2118   462.9  2116.1   465.9  2111.1   474.5  2110.9   474.7  2107.6   481.8
GR2105.6   489.1  2104.3   496.6  2103.9   499.5  2100.6     517  2098.6   536.1
GR2098.4   539.2  2096.9   546.2  2096.8   550.9  2096.2   555.3  2094.9   561.1
GR2094.9     567    2096   578.6    2096   580.1  2096.4   580.3  2096.8   584.5
GR2101.5   600.7  2102.2   603.6  2102.7   603.8    2103   605.1  2102.4   605.2
GR2103.1   606.5  2103.7   606.7  2104.1   609.6  2104.7   609.7  2105.1   612.4
GR2105.5   612.5  2107.4   618.3  2107.7   618.4  2108.5   622.6  2109.8   632.8
GR2110.7   635.8    2111   635.9  2111.8   638.8  2114.6   646.3  2118.7   656.4
GR2120.4   662.2    2121   662.3  2121.4   665.2  2138.6   702.7  2138.6   717.2
HD36.842      30   465.9   646.3
```

CROSS SECTION #RM137.049

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X137.049      80   765.2  1065.9  1141.3  1141.3  1141.3
GR2128.5     677  2128.3   679.5  2129.2   683.9  2128.6   684.3  2129.5   686.4
GR  2131   693.1  2136.6   706.8  2138.1   711.6  2137.7   712.4    2138   715.6
GR2137.2   741.4    2135   743.3  2134.4   765.2  2122.5   802.9  2122.5   803.4
GR2121.2   805.7  2120.6   806.1  2120.6   806.5  2118.3   810.1  2116.7   812.2
GR2112.6   821.8  2111.4   826.5  2110.2   829.8  2109.5     833  2109.1   836.6
GR2107.9   845.2  2107.2   846.4  2106.3   851.7  2105.8   852.5  2105.3   856.3
GR2105.1   859.4  2104.6   875.4  2104.4   876.2  2104.7   878.1  2103.8   885.9
GR2103.4     892  2101.5   911.9  2101.4   914.9  2101.4   918.4  2101.1   924.5
GR2101.1   942.6  2100.6   948.1  2098.1   964.4  2097.9   971.4  2099.3   980.8
GR2099.2   981.7  2099.4   981.9  2103.9   994.9  2103.9   995.5  2108.3  1005.2
GR2115.6  1015.3  2118.1  1017.3  2118.1  1018.6  2121.4  1020.5  2120.2  1021.8
GR2123.3  1023.9  2123.1  1024.3  2131.3  1058.1  2131.7  1059.3  2131.4  1063.5
GR2131.7  1065.9  2130.4  1083.7  2130.7  1086.9  2130.7    1102  2129.6  1118.2
GR2131.5  1147.2  2130.1  1150.1  2128.5  1177.6  2129.1  1181.8  2127.7    1197
GR2127.4  1198.1  2128.2  1200.2  2127.2  1219.7  2127.9  1220.6  2127.2  1223.8
GR2127.8  1224.4  2128.2  1253.6  2127.7  1258.8  2128.3  1261.8  2128.1  1271.2
HD37.049      30   812.2  1015.3
```

CROSS SECTION #RM137.260

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X137.260      50   287.9   564.4  1129.7  1129.7  1129.7
GR2137.2   228.7  2135.2   242.8  2132.4   246.9  2132.1   254.3  2131.1   256.1
GR2131.2   257.3  2131.9   257.5  2132.1   263.5  2128.8   272.7  2132.4   287.9
GR2122.4   320.1  2120.3   322.8  2120.8   323.1    2115   330.2  2108.2   342.1
GR2102.5   355.3  2099.9     361  2098.9   367.1  2100.4   377.5  2099.6   380.5
GR2096.7   385.9  2096.4   389.1  2097.5   397.7  2096.5   404.1  2097.5   421.6
GR2100.7   456.6  2102.1   468.4  2104.6   484.7  2107.4   496.3  2109.3   500.6
GR2113.6     508  2120.1   518.4  2132.3   551.8  2133.7   563.2  2134.2   564.4
GR2132.3   582.9  2130.9   587.1  2129.6   587.3  2132.7   595.7  2134.4   616.2
GR2133.1   638.3  2130.8   646.7    2132   682.9  2131.6   691.1    2133   691.5
GR2133.4   712.4  2134.3   721.4  2133.2   744.8  2134.6   748.7  2135.1   773.6
HD37.260      30   330.2   508.0
```

CROSS SECTION #RM137.492

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X137.492      80    1068  1393.5  1240.3  1240.3  1240.3
GR2127.9  1031.5  2127.8  1038.1  2128.5  1039.5  2129.1  1040.2  2130.6  1046.5
GR2132.1  1051.1  2135.9    1058  2137.2  1067.6  2137.4    1068  2136.9  1079.3
GR  2136  1082.2    2135  1087.3  2133.6    1089  2133.5  1090.7    2121    1133
GR2119.4  1136.3  2117.2  1139.4  2117.5  1139.6  2115.5  1142.7  2114.1  1145.8
GR2114.2  1146.2  2112.6  1149.1  2112.8  1149.3  2112.6  1149.5  2107.8  1159.4
GR2106.6  1162.3  2105.6  1165.6  2105.8  1165.8  2104.9  1168.9  2105.5  1169.1
GR2104.7  1172.2  2105.4  1172.4  2104.6  1175.5  2104.9  1175.7  2104.6  1178.8
GR2104.8  1185.4  2106.1  1198.4  2106.2  1198.6  2106.5  1208.3  2106.5  1211.6
GR2106.8  1221.7  2106.8    1251  2106.9  1254.3  2106.9  1270.8  2106.6  1280.5
GR2106.7  1287.1  2106.6  1287.3  2106.6  1307.1    2107    1310  2106.9  1310.2
GR2108.8  1316.6  2108.6  1316.8  2109.6  1319.7  2111.5  1329.6  2116.7  1339.7
GR2120.5  1346.1  2120.9  1346.3  2129.4  1374.1  2130.4  1376.8  2131.7  1387.4
GR2132.2  1393.5  2131.2  1394.9  2130.8  1396.8  2131.5  1444.3  2131.1  1453.7
GR2131.3  1453.9  2131.6  1480.3  2131.3  1481.1  2131.6  1486.9  2131.6  1496.8
GR2130.6  1543.5  2130.6    1548  2130.2  1552.7  2130.5  1555.6  2130.4  1567.7
GR2130.3    1568  2131.2  1569.5  2131.2  1569.8  2130.3  1571.1    2131    1578
```

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HD37.492      30  1136.6  1339.7

   CROSS SECTION #RM137.657
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X137.657      80  1077.7  1497.6   880.6   880.6   880.6
GR2127.3  1002.3  2126.2  1011.8  2126.3  1013.8  2127.2  1016.7  2128.4  1022.5
GR2128.8  1025.7  2130.4  1028.6  2130.5    1035  2131.2  1035.6  2131.8  1037.2
GR2131.3  1040.3  2135.9  1050.2  2137.5  1059.6  2137.2    1063  2137.6  1067.9
GR2138.1  1068.2  2137.7  1068.6  2138.6  1071.1  2138.6  1077.7  2135.2  1089.5
GR2133.7  1091.2    2128  1103.9  2128.2  1115.7  2129.5  1137.6  2128.9    1142
GR2129.4  1144.3    2130  1145.2    2123  1230.1  2124.3  1230.9  2116.7  1247.3
GR2114.2  1253.7  2113.3  1256.5  2111.8  1263.1  2111.6  1269.7  2111.7  1270.9
GR2111.7  1283.4  2111.5  1296.1  2111.2  1300.9  2110.4  1316.9  2110.1  1319.3
GR  2110  1322.6  2109.1  1329.8  2107.6  1352.6  2107.8  1353.6  2107.1  1365.7
GR2106.8  1366.9  2106.7    1369  2106.3  1370.2  2106.3  1372.3  2106.1  1372.7
GR2105.3    1386  2104.8  1390.1  2103.9  1396.1  2103.1  1405.1  2102.4  1412.1
GR  2102  1412.7  2102.1  1415.3  2101.6    1416  2101.9    1419  2102.8  1422.5
GR2106.1  1429.7  2110.1  1436.1    2110  1436.5  2111.8  1438.9  2111.9  1439.8
GR2112.9  1441.6  2120.5  1462.9  2130.8  1493.9    2131  1497.6  2130.9  1517.3
GR2131.4  1520.4  2131.1    1535  2130.5    1545  2130.7  1545.1  2130.1  1590.1
GR2130.3    1591  2129.8  1661.8  2129.8  1714.5  2129.6  1726.4  2129.8  1818.5
HD37.657      30  1247.0  1462.9

   CROSS SECTION #RM137.835
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X137.835      80  1229.1  1493.9   950.8   950.8   950.8
GR2132.9   821.3  2130.4   856.3  2129.6     858  2130.3   859.4  2129.3   861.1
GR2129.8     864  2129.5   869.3  2129.6   944.7  2131.1  1120.7  2130.4  1136.9
GR2131.6  1148.7  2131.1  1150.1  2132.9  1193.1  2132.6  1217.8    2133  1226.1
GR2133.4  1229.1  2120.6  1275.7  2121.4  1275.9  2119.6    1279  2119.1  1279.2
GR2115.4  1285.6  2114.8  1285.8  2113.4  1288.8  2112.3  1289.1  2111.3  1292.1
GR2110.3  1292.3    2107  1298.7  2106.4  1298.9  2104.7    1302  2103.3  1305.3
GR2102.4  1308.6  2101.2  1318.5  2098.5  1334.7  2097.9  1341.3  2095.5  1357.8
GR2095.2  1361.1  2095.3  1367.7  2094.1  1374.3  2094.3  1377.4  2093.6  1377.6
GR2094.7  1380.7  2093.5  1380.9  2095.2    1384  2093.8  1384.2  2095.4  1387.2
GR  2095  1387.5  2096.4  1390.7  2098.4  1403.7  2098.7  1410.3  2099.1  1413.6
GR2101.9  1426.6  2102.3  1426.8  2103.2  1429.9  2104.8  1433.2  2104.7  1433.4
GR2107.1  1436.4  2106.7  1436.7  2109.4  1439.7  2109.1  1439.9  2110.7  1443.2
GR2112.8  1446.3  2112.4  1446.5  2115.8  1449.6  2114.6  1449.8  2117.8  1452.9
GR2117.1  1453.1  2120.5  1456.2  2119.4  1456.4  2129.4  1478.6  2131.2  1493.9
GR2131.2  1528.3  2131.5  1531.6  2130.5  1554.6  2130.7    1568  2130.4  1593.9
GR2130.5  1649.9  2130.8  1666.2  2130.5  1677.7  2130.6  1685.7  2130.4  1694.4
HD37.835      30  1288.8  1449.8

   CROSS SECTION #RM138.027
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.027      80   107.1   387.6  1031.7  1031.7  1031.7
GR2131.9       0  2132.5      .5    2131   107.1  2123.6   128.3  2123.8   130.1
GR2123.1   130.9  2123.2   131.9  2122.6   132.7    2123   132.9  2121.9   136.5
GR2120.5   138.2  2120.2   139.2  2116.9   145.8  2114.5   150.1  2111.9   157.3
GR2111.9   158.4  2111.5   159.1  2111.6   160.2  2111.2   171.9  2111.3     173
GR2111.1   173.7  2110.3   195.6  2110.4   196.7  2109.9   206.8  2109.9   212.1
GR2110.5   218.7  2110.8   220.2    2110   222.1  2110.2     223    2110   225.6
GR2110.4   225.9  2109.7   228.2  2109.2   231.1  2109.3   232.2  2108.1   244.1
```

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GR2107.8   248.6  2107.4   249.3  2107.7   249.5  2105.7   269.5    2105   278.4
GR2105.1   279.5  2104.8   280.1  2105.1   280.5  2104.8   281.3  2104.9   282.3
GR2104.6     283  2104.7   284.1  2103.8   291.9    2104   292.2  2103.8     293
GR2102.8   303.1  2101.6   312.1  2101.4   317.7  2101.3   318.4  2101.5   318.7
GR2101.4   319.4  2101.7   323.3  2102.4   326.7    2105     335  2105.3   336.9
GR2106.8   341.5  2107.3   342.2  2108.9   345.9  2109.2   346.9  2109.8   347.6
GR2113.1   354.1  2114.1   354.9  2114.6   355.9  2115.7   356.6  2116.7   358.6
GR2117.3   359.4  2130.2   387.2  2130.5   387.6  2130.2   388.1  2129.6     393
GR2129.8   393.2  2130.2   397.2  2129.7   402.3  2129.6   422.4  2129.9   425.6
HD38.027      30   150.1   354.9
```

CROSS SECTION #RM138.217

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.217      80   172.5     448  1022.8  1022.8  1022.8
GR2127.3       0  2126.5     1.2    2132   112.2    2132   116.5  2132.3   123.1
GR2128.1   172.5  2119.9   182.5    2119   183.7  2119.3   184.2  2117.9     185
GR2118.6   185.5  2117.2   186.7  2117.8   187.1  2116.1     188  2116.3   188.4
GR2115.5   189.7  2115.5   190.3  2114.5     191  2114.7   191.6  2112.5   195.2
GR2112.9   195.9  2112.2   197.1  2112.2   197.7  2111.1   198.4  2111.7     199
GR  2110   201.5  2110.2   202.1  2109.3   202.8  2109.2   203.3  2108.7   204.5
GR2108.7     205    2108   205.8  2106.7   210.5  2105.7   217.8  2105.6   219.5
GR2105.6     224  2105.8     227  2107.3   234.3  2108.3     244  2108.5   244.4
GR2108.5     252  2108.2   259.4  2108.2   264.8  2108.1   265.3  2108.1   281.3
GR2108.5   288.6  2108.5   290.3  2108.7   300.1  2108.9     306  2109.1   322.1
GR2109.6   330.6  2109.6     334  2109.3   335.3  2109.6   336.6  2109.4   337.3
GR2109.5   338.6  2109.5   345.9  2109.6   348.3  2109.6   356.1    2110   367.6
GR2109.8   372.7  2109.8   379.4  2110.1   385.5  2110.6   388.4    2112   393.2
GR2115.1   400.6    2120   409.2  2120.3   410.4  2120.8   410.9  2120.9   411.7
GR2121.6   412.1  2129.1   437.7  2131.3     443  2131.5     448  2130.1     459
GR2130.1   468.4  2129.8   469.3    2130   474.5  2131.1   481.9  2130.9   485.2
HD38.217      30   191.0   400.6
```

CROSS SECTION #RM138.409

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.409      79   143.8   458.2  1037.2  1037.2  1037.2
GR2124.6    96.1  2125.5   101.9  2125.9   103.1  2125.8   106.2  2129.4     112
GR  2132   117.4  2136.7   135.8  2136.4   137.9  2136.6   143.8  2136.2   151.6
GR2133.2   168.9  2130.7   180.8  2128.6   186.1  2129.8   190.1  2121.3   211.2
GR2120.5   211.4  2121.1   212.2  2119.9   213.1    2120   213.9  2119.1   214.9
GR2117.6   215.9  2117.4   216.8  2116.3   217.6  2115.8   218.5  2113.8   220.3
GR2113.7   221.2  2113.1   222.1    2112     223  2111.8     224  2107.8   230.3
GR2106.9   233.8  2106.4   234.7  2106.8     235  2106.3   235.6  2105.5   240.4
GR2104.8   243.1  2103.9   248.6    2104   249.4  2103.8     253  2102.9   262.1
GR2103.2   269.5  2103.9   277.6  2104.2   284.1  2103.9   289.3  2103.7   298.8
GR2104.5   309.5  2105.1   314.1  2105.7   322.2    2106   324.9  2106.2   332.3
GR2106.9     345    2107   354.9  2106.9   362.3  2106.3   373.3  2106.4   374.2
GR2106.4   381.3  2106.6   384.2    2107   386.8  2107.6   389.5  2111.4   402.3
GR2113.9   409.7    2117   415.9  2117.7   416.9  2117.7   417.7  2119.2   419.6
GR2119.1   420.5    2120   421.4  2120.6   423.2  2129.1     441  2130.4     446
GR2131.7   458.2  2131.5   466.5  2130.2   481.7  2130.1   486.2  2130.1   504.6
GR2129.9   506.4  2129.9   513.4  2130.3   517.7    2130   526.9
HD38.409      30   220.3   409.7
```

CROSS SECTION #RM138.592

```
NC .0291   .0291   .0331
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```
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.592      80   168.3   472.9   988.3   988.3   988.3
GR2125.5    69.3  2126.1    74.4  2125.5    89.7  2124.5    94.7  2124.2   109.3
GR2125.3     124  2127.4   124.6  2126.4   128.6  2132.8   146.9  2133.5     147
GR2132.6     151    2134   154.3  2136.7   168.3    2136   184.9  2128.3   228.1
GR2121.5   242.6  2119.1   244.9  2119.6   245.5  2117.7   247.2  2117.3   247.9
GR2109.2     259  2098.5   279.9  2098.8   280.8  2096.6   284.6    2097   284.9
GR2095.1   289.1  2095.3   289.6    2091   310.6  2090.1   315.5  2089.1     327
GR2089.9   343.3  2091.7   352.6  2092.9   354.4  2092.4     355  2093.9   356.9
GR2093.2   357.6  2095.3     359  2094.4   359.7  2096.2   361.4  2095.4   362.3
GR2097.2   363.5  2096.6   364.4  2098.3   370.5  2097.6   371.4  2098.8   375.3
GR  2098   376.1  2098.8   377.7  2098.4   378.2  2101.9   400.9  2105.8   414.7
GR2105.2   415.6  2107.1   417.3    2106   417.6  2105.9     418  2108.1   419.4
GR2107.6   419.8    2106   420.1  2109.3     422  2107.7   422.3  2107.1   422.6
GR2110.4   424.1  2108.1   424.7  2111.5   426.7  2110.2   426.8  2109.9   427.3
GR2112.8   428.8  2110.8   429.3  2114.6   433.6    2116   436.2  2118.9   440.5
GR2129.7   467.9  2129.8   470.4  2131.1   472.9  2128.7     475  2131.6   482.4
GR  2131   489.1  2130.4   501.6  2130.4   515.1    2132   532.5  2131.2   540.4
HD38.592      30   259.0   429.7
```

CROSS SECTION #RM138.765

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.765      80  1115.8  1486.8   936.4   936.4   936.4
GR2130.1   864.7  2131.1   874.4  2130.4     884  2132.4   889.2    2132   908.6
GR2132.4   908.7  2132.6   913.9  2131.1   959.8  2130.8  1007.6  2129.4  1022.2
GR2131.8  1032.4  2133.9  1045.2  2133.7  1082.9  2134.1  1099.6  2133.3  1103.9
GR2133.8  1104.5  2133.9  1115.8  2133.4  1123.8  2131.1  1142.4  2130.6  1143.4
GR2130.9  1145.3    2131    1162  2131.2  1162.2    2121  1192.2  2120.2  1202.1
GR2118.7  1215.1    2118  1215.3  2117.2  1218.3  2113.1  1228.2  2112.4  1231.5
GR2111.6  1244.9  2111.4  1254.6  2109.5  1280.7  2108.1  1294.1  2105.4  1307.3
GR2103.9  1329.9  2102.8  1339.8  2101.8  1356.3  2101.3  1362.9    2101  1363.1
GR2101.4  1366.1  2101.2  1366.4  2104.1  1375.8  2103.9    1376  2106.1  1385.9
GR2107.3    1389  2112.7  1398.9  2113.4  1399.1  2118.1  1408.8  2119.5  1412.1
GR2120.4  1412.3  2131.7  1449.7  2132.2  1462.7  2132.5  1486.8  2131.9  1487.4
GR2132.1  1489.1  2131.2  1506.7  2131.2  1531.4  2130.8    1543  2131.1  1543.1
GR2130.6  1546.5  2131.3  1558.2  2131.2    1573  2130.6  1574.5  2131.1  1576.1
GR2131.2  1577.7  2130.8  1592.6  2131.1  1592.8  2130.5  1615.4  2130.8  1621.6
GR2130.4  1626.9  2130.1  1659.4  2130.3  1663.2  2129.5  1676.2  2129.6  1681.2
GR2129.1  1689.5  2128.9  1702.5  2129.3    1727    2129  1730.3  2129.1  1747.2
HD38.765      30  1231.5  1398.9
```

CROSS SECTION #RM138.991

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X138.991      80   141.4   511.4    1221    1221    1221
GR2131.7   112.8  2131.7   138.1  2132.1   141.4  2121.1   183.8  2121.5   184.3
GR2120.2   186.9  2120.9   187.3  2118.3   190.1  2119.4   190.5  2116.8   193.1
GR2115.4   194.1  2116.5   194.6  2108.9   202.8    2107     205  2105.1   207.6
GR2102.5     214  2103.3   214.4  2102.6   215.3  2101.6   217.9  2102.4   218.5
GR2101.7   220.2  2102.2     232  2102.2   241.9  2102.5   242.4  2102.4     245
GR  2104   260.1  2104.5   266.2  2106.5   280.6  2107.6   291.9  2108.2   303.1
GR2108.2   308.5  2108.3   309.4    2108   309.8  2108.3   321.3  2108.5     323
GR  2108   323.5  2108.4     327    2108   327.4  2108.3   330.2  2107.9   330.8
GR2108.1   332.5  2107.7   337.9    2108   340.5  2107.6   341.2  2107.7     342
GR2107.9   343.9  2107.5   344.3  2107.6   346.1  2107.1   352.3  2105.8   361.7
GR2105.4   369.1  2105.6   375.4  2106.1   381.2  2106.8   385.7  2106.8   391.5
```

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GR2107.8   397.9  2109.9   404.2  2112.6   410.4  2112.8   411.3  2117.7   420.7
GR2117.3   421.6  2118.8   423.1  2119.2     425    2119   425.8    2120   426.3
GR2120.1   427.2    2121   428.1  2127.9   496.9  2128.2   502.2  2129.8   508.8
GR2129.9   511.4  2129.5   512.1  2129.7   516.8  2129.5   518.5  2129.7   519.9
GR2129.1   554.3  2127.6   554.5  2130.4   565.6  2129.9   569.2    2130   573.8
HD38.991      30   205.0   391.5
```

CROSS SECTION #RM139.160

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X139.160      80   150.6   460.7   857.2   857.2   857.2
GR2132.1   129.5  2132.5   150.6    2130   164.9    2121   185.3    2120   185.7
GR2114.9   191.8  2114.3   192.1  2104.5   208.5  2104.2   211.5  2102.6   212.3
GR2103.4   214.6  2101.8   215.3  2102.7   217.9  2101.3   218.8  2102.2   221.4
GR2100.7   222.2  2101.3   224.6  2100.2   225.2  2097.9   231.2  2094.6     232
GR2095.7   234.4    2093     235  2090.8   235.2  2093.4   237.6  2088.4   238.5
GR2089.3   241.1  2087.7   241.5    2085   241.7  2084.3     242    2088   244.4
GR  2084   244.9  2083.1   245.2  2086.9   247.9  2082.3   248.4  2081.2   248.8
GR2084.2   251.2  2081.8   251.4  2080.4   251.7  2081.8   254.3  2080.2   254.6
GR2079.3   255.2  2080.2   257.5  2078.6   258.4  2078.9   261.2  2076.8   261.7
GR2077.5   267.3  2075.8   267.8  2077.3   270.4    2075   271.1  2074.6   277.5
GR2071.2   278.4  2074.1   280.7  2071.4   281.6    2074     284  2072.2   284.5
GR2074.4   287.2  2072.8   288.2  2074.1   291.1  2073.5   291.4  2078.9   307.2
GR2078.6   307.8    2083   317.2  2093.3   343.4  2094.6   356.9    2094   357.5
GR2095.8   359.7  2094.4   360.7  2097.1   369.9  2096.6   370.4  2101.9   379.8
GR2106.7   389.8  2108.1   395.9  2107.5   396.5  2111.7   416.4  2112.8   419.1
GR2118.1   429.1  2119.5   429.4  2132.4   460.7  2129.9   479.6  2130.1     503
HD39.160      30   212.3   379.8
```

CROSS SECTION #RM139.341

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X139.341      80   161.6   453.8   918.9   918.9   918.9
GR2131.8    95.3  2131.1   120.2  2130.2   120.6  2130.6   121.8    2131   127.9
GR2130.8   128.3    2131   143.5  2130.7   144.3  2130.4   144.6  2131.1   151.9
GR2131.4   161.6  2121.6   194.3  2121.7   194.9  2121.4   197.5  2120.6   200.1
GR2119.9   201.5  2119.6   202.7  2119.5   204.2  2118.7   207.3  2118.1     208
GR  2118   208.6    2118   213.2  2118.1   213.8  2117.2   215.2  2117.7   215.8
GR2117.5   220.5  2118.5   221.1  2117.8   222.5  2118.6   223.9  2117.7   224.6
GR2117.6   225.2  2117.9   225.8  2117.1   227.1  2117.2   228.4  2115.4   231.7
GR2113.8   236.9  2113.1   238.8  2113.2   240.1  2112.2   240.9  2112.6     242
GR2111.9   243.3  2112.6   244.7  2111.8     246    2112   246.7  2111.6     248
GR2111.5   250.6  2111.1   253.3  2111.1     256  2110.1   279.4  2107.9   315.2
GR2107.6   316.1  2105.6   335.9  2105.2   347.1  2103.7   362.9  2103.7     368
GR2103.8   371.4  2104.1   372.1  2104.4   381.8  2105.5   391.7  2105.9   393.7
GR2105.8   394.3  2106.6   395.7  2106.4   396.4  2109.5   404.2  2110.3   404.9
GR2110.6   406.2  2111.3   407.5  2117.1   417.5  2117.1   418.1  2118.7   419.4
GR2118.5   420.6  2119.9   421.4  2119.7     422  2119.8   422.8  2130.9   450.7
GR2131.4   453.8  2130.8   456.7  2131.4   457.2  2131.2   457.7  2132.6   580.2
HD39.341      30   236.9   407.5
```

CROSS SECTION #RM139.533

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X139.533      80   149.2   466.4   967.8   967.8   967.8
GR2127.8    89.3  2131.1     118  2131.5   118.3  2130.8   119.8    2132   120.2
GR2131.2   120.5  2131.1   121.4    2132   121.7  2131.4     138    2131   141.9
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GR2131.7   148.4  2131.2     149  2132.1   149.2  2131.4   149.5  2131.3   149.6
GR2131.6     151  2131.5   157.6  2129.8   173.2  2120.2   191.3  2120.1   192.7
GR2119.1   193.1  2118.7   194.5  2118.6   195.6  2117.4   196.1  2116.3   198.9
GR2111.6   207.3  2109.5   211.7  2108.4   214.5  2108.6   215.2  2107.8   216.3
GR2107.9   216.8  2107.7   217.8  2107.1     219  2106.8   221.2    2106   223.7
GR2106.1   224.1  2105.4   226.6  2105.5   227.1    2105   228.1  2105.1   228.8
GR2104.8   229.3  2104.2   232.6  2104.1   235.4    2105   248.9  2105.4   249.9
GR2106.7   260.8  2107.3   263.6  2108.2   270.8  2107.9   275.3  2107.5   276.4
GR2107.6   276.9  2107.3   278.2  2107.1     281  2108.3   299.1  2108.3   304.6
GR2108.9   314.9  2109.4   328.3  2109.8   349.3  2109.8   357.5  2109.7   358.1
GR2109.7   372.6  2109.8   377.1  2110.4   379.8  2111.3   382.9  2113.3   387.3
GR2113.8   388.6  2118.4   396.9  2118.8   397.3  2121.8   403.7  2122.6   405.9
GR2122.9   406.3  2123.3   408.1  2129.3   428.2  2129.9   432.9  2130.3   437.9
GR2131.1   466.4  2131.1   478.3  2130.9   478.6  2131.5   563.3  2129.6   618.4
HD39.533      30   207.3   382.9
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CROSS SECTION #RM139.732

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X139.732      80   182.4   488.3  1008.9  1008.9  1008.9
GR2132.8   150.2  2134.9   157.9  2135.8   162.7  2136.4   168.8  2135.9   175.2
GR2136.4   175.8  2136.1   182.4  2134.4   189.7  2120.1   211.8  2121.6   211.9
GR2119.7   214.1  2118.5   216.3  2118.8   216.4  2118.5   216.5  2116.7   218.6
GR2116.1   220.9  2116.6     221    2116   221.1  2113.6   223.3  2114.2   223.4
GR2112.1   225.6  2109.5   230.2  2107.7   232.5  2104.6   237.4  2104.3   239.5
GR2103.5   239.7  2103.7   239.8  2102.2   241.8  2102.6   241.9  2102.3     242
GR  2102   244.3  2101.1   246.6  2099.9   248.9  2100.6     249  2099.7   251.3
GR2098.7   255.8    2098   260.4  2098.2   260.6  2097.4   262.8    2097   267.4
GR2096.3   269.6  2096.4   269.7    2096   274.4  2095.9   278.9  2095.9   281.5
GR2096.2   288.3  2097.4   297.5  2097.6   297.6    2101   318.7    2102   323.2
GR2102.6   325.4  2103.1     330  2103.9   334.7  2104.3   334.8  2104.7   339.4
GR2105.5   343.8  2105.3   343.9  2105.7     344  2106.1   350.9  2106.6   355.4
GR2106.5   355.7  2107.2   362.4  2107.3   362.6  2107.6   369.4  2108.9     381
GR2109.3   383.3  2110.7     388  2110.6   388.1  2113.5   395.1  2114.7   397.4
GR2117.5   401.9  2117.4   402.1  2119.3   404.4  2121.3   406.6  2122.5   408.9
GR2122.4     409  2132.2   488.3  2131.5   496.1  2131.4   503.4  2129.3   540.7
HD39.732      30   223.3   395.1
```

CROSS SECTION #RM139.937

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X139.937      80   456.7   767.4  1037.2  1037.2  1037.2
GR2133.9   420.8  2136.1   424.8  2136.1   429.1    2137   434.4  2137.5   435.9
GR2137.4   441.4  2136.6   445.9  2137.1   447.4  2136.3   456.7  2135.9   457.4
GR2135.5     459  2136.2   459.7  2135.5   462.5    2124   489.9  2123.8   491.2
GR2123.4   492.2  2122.5   493.1  2122.1   493.3    2122   494.4  2120.5   496.5
GR2120.4   497.4  2119.3   498.4  2118.6   499.5  2118.3   500.3  2117.8   500.7
GR2117.6   501.6  2116.7   502.6  2115.8   503.9  2112.2   510.7  2112.2   511.2
GR2111.8   511.8  2110.5   515.2  2109.6   518.4  2108.8   524.6  2108.7   527.5
GR2108.8   528.4  2108.6   528.8  2108.8   530.7  2108.9   537.9  2108.9   546.4
GR2109.1   550.3  2109.1   556.4  2108.7   573.2  2108.5   588.6  2108.3   589.8
GR2108.4   592.8  2108.1   605.1  2107.7   616.8  2108.1   629.4  2107.9   631.3
GR  2107     646  2106.5   650.9  2106.3   658.3  2106.3   665.5  2106.5   665.8
GR2106.4   666.6  2106.5   669.6  2107.3   672.8  2107.8     674  2109.7     677
GR2111.5   678.9  2112.2   680.2  2116.2   685.3  2117.5   687.4  2118.3   688.5
GR2121.6   694.7    2123   698.9    2123   699.8  2123.9     700  2135.5   748.1
GR2135.7   767.4  2135.3   774.2  2135.4   774.8  2134.1   775.9    2135   777.9
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GR  2135   783.6    2134   801.8  2133.7   802.1  2133.2   807.8  2133.4   813.3
HD39.937      30   502.6   685.3
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CROSS SECTION #RM140.107

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X140.107      80   342.7   628.2   884.4   884.4   884.4
GR  2132   220.3  2133.1   223.3  2132.8   225.4  2133.7   228.1  2133.3   229.3
GR2133.6   230.7    2135   231.8  2137.1   245.6  2136.8   253.9  2134.3     267
GR  2134   271.6  2132.8   274.2  2134.3   274.4  2132.8     276  2132.8   276.9
GR2134.1   277.9  2132.7   278.5  2133.2   283.6  2132.8   303.2  2130.9   338.8
GR2132.1   342.7  2124.6   387.8  2123.5   388.5    2124   389.6  2122.7   390.3
GR2123.4   390.6  2122.5   391.2  2121.3     394  2120.5   395.2  2119.9     397
GR2118.6   398.8  2115.2   408.7  2115.3   409.6  2114.8   409.7  2112.7   419.5
GR  2111   432.4  2110.6   433.1  2111.3   438.7  2111.5   443.2  2111.3   454.3
GR2110.5     469  2109.5   477.9  2108.4   485.8  2107.2   497.1  2106.2   503.3
GR2104.8   514.5  2104.4   528.8  2104.2   530.9  2104.5   538.9    2105   543.3
GR2105.8   547.9    2107   552.3  2109.4     558  2110.2   558.9  2114.8   567.2
GR2115.7   567.9  2116.8   569.1  2117.6   571.6  2118.8   572.5  2119.9   573.6
GR2119.9   574.3  2121.5   575.3  2120.6     576  2122.8   576.4  2122.8   577.1
GR2123.9     578    2123   578.7  2124.6   579.9  2124.6   580.8  2125.5   582.9
GR2124.4   583.5  2124.2   584.5  2125.1   586.1  2128.6   618.3  2131.6   628.2
GR2131.2   651.4    2130   677.6  2130.3   677.9  2130.1   681.1  2129.6   709.9
HD40.107      30   398.8   572.5
```

CROSS SECTION #RM140.269

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X140.269      80   627.8   926.4   848.2   848.2   848.2
GR2134.1     476  2134.8   477.1  2134.4   477.9  2136.4   484.7  2136.8   488.1
GR2137.4   490.9  2137.4   494.7  2136.9   494.9  2136.6   498.1  2136.6   505.1
GR2136.1   506.6  2136.3   509.8  2135.5     510  2134.6   513.9  2130.7   536.2
GR2131.1   551.6  2132.8   567.9  2133.9   570.6    2134   576.6  2134.4   582.3
GR2134.3   586.3  2133.8   588.3    2133   597.4  2132.3   599.5  2133.3     601
GR2132.3   601.6  2132.4   620.7  2132.9   627.8  2129.4   633.5  2130.6   634.6
GR2118.9     668  2113.4   676.5  2111.8   679.6  2110.2   683.5  2109.5   687.5
GR2109.6   688.1  2109.1   699.2  2109.1   706.4  2109.4   713.9  2109.1   734.5
GR2108.5     746  2108.5   767.4  2108.3   768.1  2107.8   786.4  2107.2   805.1
GR2107.2   824.8  2107.4   829.1  2107.4   838.6  2108.3   843.5    2110     848
GR2111.7   850.8  2112.6   852.9  2113.6   853.9  2114.2   855.2  2115.4   856.9
GR2117.2   860.1  2117.6   861.4  2118.3     862  2120.4   867.5  2120.6   868.6
GR2123.9   876.7  2131.9   926.4  2131.5   927.9  2131.2     930  2131.4   934.3
GR  2131   942.8  2131.2   943.2  2130.7   944.3  2130.4   945.9  2130.1   951.1
GR2130.3   951.9  2129.8   954.5  2129.8   964.2  2129.1   969.1  2129.9   972.6
GR  2129   979.3  2128.4   980.8  2129.2   981.9  2129.3   989.7  2129.1   991.9
HD40.269      30   668.0   862.0
```

CROSS SECTION #RM140.443

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X140.443      80   777.8  1131.2   913.6   913.6   913.6
GR2130.6     701  2132.1   707.7  2133.1   709.6  2136.8     727  2133.2   738.3
GR2131.4     742  2131.7   777.8  2128.1   786.1    2126     814  2124.6   820.4
GR2124.6   824.6  2123.1     826    2123   831.7  2123.2   833.9  2122.7     835
GR2121.9   835.6  2122.3   837.1  2121.6   838.7    2122   839.5    2120   842.7
GR2120.4   843.5  2118.8   845.2  2118.3     846  2118.4   846.6  2116.9   848.3
GR  2116   849.1  2115.9   849.9  2113.8   852.2  2109.7   858.7  2107.5   862.9
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GR2105.4   867.4  2103.8   872.2  2103.6   874.5  2103.8   876.8  2104.9   881.8
GR2105.6   886.6    2106     892  2106.5     908  2107.2   922.3  2107.2   930.2
GR2107.3   931.7  2107.3   940.8  2107.5   942.3  2108.7   948.5    2110   964.6
GR2110.4   980.6    2111   989.9  2113.5  1009.9  2114.8  1013.9  2117.9  1020.3
GR2118.9  1020.9  2119.4    1022  2119.6  1023.4  2120.3  1024.3  2122.2    1029
GR2122.5  1032.2  2124.4  1037.8  2124.1  1038.6  2124.7  1042.6    2125  1043.2
GR2124.4    1044  2124.2  1045.1  2125.2  1045.7  2124.4  1046.5  2124.2  1047.1
GR2125.3  1049.6  2124.4  1050.5  2125.8    1053  2124.3  1055.3  2128.1  1063.2
GR2133.4  1131.2  2132.6  1134.3  2132.3    1143  2133.2  1152.4  2132.4  1162.4
GR2132.7    1169  2131.8  1180.1    2132  1180.5    2132  1198.2  2129.5  1245.2
HD40.443      30   846.0  1020.3
```

CROSS SECTION #RM140.636

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X140.636      80   416.3   725.8  1018.9  1018.9  1018.9
GR  2129   387.8  2129.8     393  2130.8   395.9  2130.7   396.7  2131.7   397.4
GR2133.1   400.4  2132.5   400.5  2133.4   401.2  2134.2   403.2  2133.6   404.1
GR2135.8   406.3  2137.5   416.3  2137.3   419.9  2134.6   430.9  2135.1     431
GR2134.9   432.5  2134.4   433.1  2132.4   434.9  2132.6   436.5  2129.8   438.7
GR2128.7   439.1  2130.2   442.7  2118.8     470  2118.6   471.6  2116.8   471.7
GR  2118   472.9  2116.9   473.1  2117.8   474.5    2117   474.6  2117.4     476
GR2116.9   476.2  2116.8   477.5  2116.3   478.9  2115.8   479.1  2114.4   483.3
GR2114.4   484.9  2113.4   486.4    2113   489.3  2112.5   490.6  2112.1   490.9
GR2111.6   493.7  2110.9   495.3  2109.7     504  2109.6   509.9  2110.9   524.4
GR2110.9   540.6  2110.6     551  2109.9   564.1  2109.8   571.4  2109.2   584.5
GR2109.2   594.8  2109.3     595  2108.2   600.5  2107.2   605.2  2107.1   606.8
GR2107.2   625.6  2107.9   638.7    2108   644.7  2109.1   650.7  2110.3   655.1
GR2111.6   658.1    2115   663.8  2116.5   666.9  2117.6   668.2  2118.1   668.3
GR  2119   669.8    2124   677.2  2124.7   678.5  2132.6   725.8  2132.3     786
GR2134.3   803.8    2135   812.8  2132.7   834.8  2133.2     837  2132.4   838.5
GR2133.2   843.9  2133.6     851  2133.3   851.2  2132.9   853.2  2132.9   860.7
HD40.636      30   470.0   669.8
```

CROSS SECTION #RM140.838

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X140.838      80   392.2   709.3  1060.6  1060.6  1060.6
GR2132.6   305.7  2136.9     315  2135.6   315.9  2136.8   317.9  2137.5     331
GR2135.3   343.5  2134.1   348.6  2127.9   362.6  2128.3   367.8  2127.9   367.9
GR2127.6   369.2  2128.1   371.9  2129.4   386.1  2132.6   387.5  2131.5   389.2
GR2132.7   392.2  2132.3   396.1  2132.4   402.6  2131.9   403.8  2131.8   408.7
GR  2123   434.5  2123.2   434.9  2122.2   435.9  2122.8   436.4  2121.6   437.2
GR2120.6   439.2  2119.6   440.6  2118.4   441.7  2118.4   442.2  2116.2   444.5
GR2116.3   444.9  2113.9     451  2112.5     458  2111.4   465.7  2111.5     467
GR  2111   471.4    2110   475.7  2110.4   476.1    2110     480  2110.3   480.4
GR2110.1   482.9  2110.4   483.3    2110   500.5  2110.7   506.4  2111.2   533.3
GR2111.2   562.7  2110.7   580.1  2110.1   597.7  2109.3   609.2  2109.1   609.7
GR2109.1   612.2  2108.5   617.4  2108.5   619.4  2107.3   630.3  2107.8   634.3
GR2109.1   637.5  2113.2   644.7  2113.8   646.1  2114.5   646.5  2115.6   648.1
GR2115.7     649  2116.6   649.5  2117.3   650.4    2119   653.3  2120.8   654.9
GR2120.5   655.3    2122   656.3  2121.5   656.7  2122.9   657.8  2123.7   659.4
GR2124.6     661  2131.5   701.9  2133.7   709.3  2133.8   712.7  2133.5   721.8
GR2133.8   734.9  2133.8   745.6  2133.1   789.4  2133.6   808.8  2133.1   823.3
HD40.838      30   444.5   648.1
```

CROSS SECTION #RM141.055

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.055      80   478.4   749.1  1141.3  1141.3  1141.3
GR2127.9     425  2127.8   432.9  2128.8   433.3  2127.9     436  2128.4   436.2
GR2127.9   437.7  2130.7     441  2132.2   443.2  2134.7   455.2  2135.8   456.3
GR2136.9   464.8  2136.9   478.4    2131   497.1    2128   500.3  2110.7   559.3
GR2110.1   560.8    2109     561  2107.4   562.3  2105.9   563.8  2102.8   565.2
GR2101.3   566.9  2099.2   568.2  2096.8     571  2096.2   571.3    2094   575.8
GR2092.1     583  2088.9   593.3  2087.9   597.5  2086.7     608  2086.1   616.7
GR2087.6   624.1    2092   632.8  2093.9   640.2  2100.1   654.6  2100.7   654.9
GR2103.8   666.6  2103.9     668  2104.2   668.4  2103.3   669.5  2104.5   669.7
GR2104.6     671    2104   672.3  2105.2   672.5    2106   678.4  2107.1   678.6
GR2105.8   679.7  2107.2   679.9  2107.2   681.3  2106.7   682.6  2108.5   682.8
GR2107.1   683.9  2108.4   684.1  2108.1   685.6  2109.7   685.8  2108.7   686.9
GR2109.6   687.2  2109.5   688.7  2110.3     690  2111.3   690.2  2111.6   691.5
GR2112.3   692.8  2113.4   693.1  2114.4   695.9    2116   697.4  2116.6   697.6
GR2117.5   698.7    2117   698.9  2117.9   700.5  2119.1   701.8  2134.1   748.1
GR2133.8   748.5  2134.1   748.9  2134.6   749.1  2133.9   750.1    2134   757.2
GR2133.7     776  2134.2   776.9  2133.8   788.6  2134.6   804.1  2133.1     827
HD41.055      30   559.3   690.0
```

CROSS SECTION #RM141.248

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.248      80   180.1   513.5  1021.1  1021.1  1021.1
GR2131.5     151  2132.5   156.5  2135.5   164.3    2136   166.4  2136.9   174.2
GR2136.9   179.1  2137.2   180.1  2136.9   187.8  2136.2   188.6    2121   245.4
GR2120.1   245.7  2114.1   257.2  2113.4   258.8  2112.8     259  2112.9   260.1
GR2112.4   260.3  2111.8   261.5  2108.9   269.1    2107   274.8  2106.7   275.1
GR2105.6   279.5  2105.4     282  2107.1   288.2  2107.8   288.4  2107.1   289.4
GR2107.8   289.7  2107.6   290.9    2108   291.2    2108   301.2  2108.1   301.7
GR2108.1   311.8  2108.3   317.5  2108.6   321.9  2108.5   326.3  2108.5   332.2
GR2108.7   333.8  2108.7   335.2  2109.7   357.1  2109.7   363.1  2109.3   374.7
GR2109.5   376.3  2109.5   382.1  2109.4   382.4  2109.1   390.8  2109.1   398.2
GR2109.5   405.6  2110.5   414.2  2110.8   420.5  2111.9   426.5  2113.1     429
GR2112.9   429.4  2116.2   436.3  2119.6   439.5  2120.7   440.8  2120.3   441.1
GR2121.8   442.3  2121.1   442.7  2121.9   443.6  2122.7   443.8  2122.5   445.1
GR2123.5   445.5  2124.5   446.7  2124.6   448.3  2125.8   449.8  2124.2   449.9
GR2130.4   472.4  2129.3   475.5  2128.8   479.3    2133   484.5  2133.2   485.5
GR2133.1   489.2  2133.5   491.6  2133.6     499  2133.3   503.6  2134.1   513.4
GR2134.3   513.5  2133.7   548.6  2133.6     549  2133.7   558.2  2133.4   565.1
HD41.248      30   245.7   439.5
```

CROSS SECTION #RM141.436

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.436      80   131.4   459.1   993.7   993.7   993.7
GR2132.6    59.6  2136.5    91.9  2136.4    98.4  2136.6    99.7  2136.3   101.5
GR2136.4   106.2  2136.7   110.1  2135.7   115.8  2136.6   118.8  2136.9   119.3
GR2138.1   131.4  2117.3   222.5  2116.6   224.4  2116.6   224.8  2115.7   225.6
GR2115.3   226.6  2111.5   233.9  2111.2   234.8  2110.8     235  2110.7   235.9
GR  2110   236.9  2109.9   238.1  2109.1   240.3  2108.5   243.2  2108.4   247.4
GR2108.4   273.2  2108.5   273.5  2108.5   276.2  2108.4   277.3  2108.4   291.1
GR  2108   304.8  2107.5   314.9  2107.1     320  2107.1   331.6  2106.8   332.5
GR2106.7   335.8  2106.3   336.6  2105.5   341.8  2105.3   344.9  2105.3     348
GR2105.5   350.3  2105.5   354.4  2105.9   356.6  2105.9   357.3  2106.3   357.7
GR2106.3   361.6  2106.6   362.7  2106.3   363.5  2106.9   363.8  2106.4   364.5
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GR2106.8   366.9  2106.8   368.7  2107.6     373  2107.7   374.1  2108.2   374.9
GR2108.2   378.3  2109.7   388.4    2110   388.8  2110.4   391.5  2110.9   391.9
GR2110.8   392.6  2113.9   401.8  2115.9   405.2    2116   406.2  2117.1   407.3
GR2117.7   409.3  2118.1   409.6    2119   411.5  2120.1   412.6  2120.1   413.5
GR2121.4   414.5  2121.4   415.8  2122.6   418.8  2121.9   419.4  2134.6   459.1
GR2134.3   461.7    2134   462.2    2134   473.2  2133.3   494.5  2133.5     495
HD41.436      30   222.5   409.3
```

CROSS SECTION #RM141.603

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.603      63   138.2   391.4   882.1   882.1   882.1
GR2131.4       0  2130.1    24.8  2130.6    50.1  2130.4      53  2131.3    73.6
GR2130.9    95.7  2130.7   100.7  2131.1   106.7  2131.2   121.1  2129.6   133.3
GR2130.9   138.2  2121.4   175.5  2118.9   180.2    2115   189.1  2112.2   197.8
GR2111.4   201.5  2110.4   210.6  2108.8   223.3  2106.5   236.1  2104.7   243.4
GR2103.6   245.4  2103.4   246.4  2100.6   251.7  2100.4   252.8    2098   258.2
GR2095.3   268.6  2094.8   276.7  2097.2   289.1  2097.1     291  2097.3   293.5
GR2098.1   296.6  2099.6   298.9  2099.7   300.5  2100.8   303.7  2101.9   306.8
GR2103.1   310.1  2103.9   313.2  2105.5   317.4  2107.5   320.5  2109.4     322
GR2110.4   323.7  2112.3   325.2  2113.1   326.9  2118.4   330.8  2120.4   332.1
GR2121.3   333.1  2121.2   333.9  2123.2   334.6  2123.8   335.4  2124.4   338.6
GR2124.2   340.2  2132.2   389.7  2132.3   391.4  2131.7   397.1  2131.6   416.2
GR2131.8   418.2  2131.6   453.1  2132.6   462.5  2132.9   473.3  2132.4   476.8
GR  2133   490.9  2132.8   493.5  2132.7   517.4
HD41.603      30   189.1   330.8
```

CROSS SECTION #RM141.780

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.780      80   157.7   440.2   931.7   931.7   931.7
GR2131.4       0  2131.8     4.3  2133.9     9.2  2136.4    33.8    2134    66.1
GR2134.9    82.8  2133.3     102  2134.6   114.1  2131.7   127.9  2132.5   137.3
GR2133.2   157.7  2131.9   162.2  2129.9   164.9  2130.7   174.2  2118.9   209.2
GR2118.6   211.4  2115.2   216.1    2114   218.3  2113.5   218.5    2110   225.4
GR2108.4   227.8  2107.7   229.9  2106.3   232.3  2105.6   234.9  2104.2   237.1
GR2102.2   241.9  2100.6   248.7  2100.8   253.3  2100.8   255.7    2101   260.4
GR2101.5   264.7  2101.7     265  2102.6   269.5    2104   274.3  2104.9   278.8
GR2105.2   285.7  2105.1   285.9  2105.9   304.3  2106.5   306.6  2107.9   325.2
GR2109.7   345.9  2109.6   346.2  2110.7   362.2  2111.1   364.6  2111.2   366.9
GR2113.6   373.8  2115.2     376  2116.6   378.4  2121.4   387.9  2121.7   390.1
GR2123.1   392.4    2124   394.8  2124.4   397.2  2125.3   399.6  2128.4   426.9
GR2132.4   440.2  2133.2   452.4  2133.1   454.6  2133.3   463.8  2134.3   467.7
GR2133.8   470.5  2134.1     475    2134   477.4    2134   489.6  2133.6   494.6
GR2133.6   498.1  2133.8   500.4  2133.9   504.5  2133.5   511.9  2133.7   517.6
GR2133.1   529.2  2133.2   536.6    2133   537.3    2133   547.3  2132.4     552
GR2132.3   559.1  2131.8   563.7  2132.1   565.2  2131.9   567.4  2131.9   574.9
HD41.780      30   216.1   378.4
```

CROSS SECTION #RM141.973

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X141.973      80   246.4   568.4  1024.2  1024.2  1024.2
GR2134.9   129.4    2136   132.9  2135.8   133.6  2137.6   144.3  2137.4   149.9
GR2134.1   167.4  2134.9   168.2  2134.1   175.9  2133.1   178.1  2129.9   211.1
GR2130.4   217.4  2134.4   246.4  2122.9   305.4  2123.7   305.9  2122.7   306.4
GR2121.4   307.3  2122.3   307.9  2121.4   308.5  2113.9   318.3  2114.3   318.9
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GR2112.6   320.1    2113   321.6    2112   322.2  2111.3   322.9  2112.5   323.5
GR2110.7   324.7  2111.3   326.2  2110.3   326.8  2109.7   327.5  2109.9   328.7
GR2109.3   329.5  2109.7   330.8    2109   331.4  2107.5     338  2107.7   339.3
GR2106.6     340  2107.2   341.2  2105.8   342.7  2106.3   343.9  2104.9   345.2
GR2105.1   345.9  2103.9   347.2  2104.1   347.9    2103   352.5  2103.9     365
GR2104.4   368.9  2105.1   378.7  2105.6   383.2  2107.9   408.9  2109.1   417.4
GR2109.8   427.8  2109.7     429  2110.1   437.8  2110.6   457.4  2111.7   469.3
GR2111.7   471.4  2112.7   481.7  2113.2     483  2113.1   484.2  2115.9   490.8
GR2116.1   491.5  2117.1   492.2    2117   492.8  2118.4   495.5  2119.7   500.1
GR2129.8   541.6  2131.4   547.4  2131.5     557  2131.9   557.9  2132.8   568.4
GR2132.6   569.7  2132.7   585.2  2131.6   699.4  2132.2   710.8  2131.7     711
GR2132.9   715.6  2134.1   731.1  2133.6   732.9    2134     737  2133.5   741.7
HD41.973      30   307.3   500.1

   CROSS SECTION #RM142.164
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X142.164      80    36.5   344.4  1023.1  1023.1  1023.1
GR2133.2       0  2136.1     4.2  2136.4     6.4  2135.8     7.8  2136.4    36.5
GR2134.9    44.2  2133.5    48.8  2133.7    50.2    2133    55.5  2122.4   105.5
GR2120.8   105.9  2120.7   107.1  2119.7   107.5  2120.6   108.2  2118.9   108.8
GR  2119   109.8  2118.2   110.5  2116.8   114.5  2114.5   118.8  2114.2   120.5
GR  2113   123.3  2112.8   124.7  2112.4     125  2111.7   126.4    2112   126.7
GR2111.4   127.5  2109.5   132.4  2107.9   138.1  2107.1   145.9  2107.3   146.4
GR2107.1   147.1  2107.4   150.9  2107.3   151.4    2108   181.8    2108     190
GR2108.3   198.8  2108.1   206.1  2108.1   212.8  2108.4   217.5  2108.5   220.8
GR2108.9   223.1  2108.7   223.6    2109   224.7  2108.8   225.3  2108.9   226.4
GR2108.9   229.7  2108.4   245.5  2108.4   256.3  2108.6   266.3  2107.9   279.5
GR2107.9   283.4  2108.2   283.8  2108.3     285  2108.7   285.5  2109.3   287.8
GR  2111   291.1  2113.2   294.5  2113.8   295.6  2115.2   297.2  2115.7   298.4
GR  2118   301.7  2118.4   302.8  2122.1   307.3  2122.3   308.7  2123.5     309
GR2122.8   310.4  2123.7   311.4  2123.4   312.1  2123.8   313.1  2124.9   314.3
GR2133.7   344.4  2133.6   361.7  2133.9   365.3  2133.5   367.8  2133.5   373.6
GR2133.4   380.3  2133.6   382.4  2133.3   411.2  2133.2   412.9  2133.4   416.6
HD42.164      30   110.5   301.7

   CROSS SECTION #RM142.333
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X142.333      80   182.9   514.6   913.3   913.3   913.3
GR2131.1   113.6    2131     120  2131.3   125.3  2131.2   127.8  2132.6   136.9
GR2133.6   150.6  2131.4   173.7  2131.6   177.4  2133.1   182.9  2121.5   240.4
GR2120.5   241.9  2120.6   243.4  2119.6   244.8  2119.3   244.9  2117.4   249.4
GR2117.6   249.5  2115.8   252.5  2114.7   255.2  2111.1   265.5  2109.8   271.3
GR2109.7   272.8  2109.7   280.2    2110     289  2110.3   302.2  2110.3     314
GR2110.1   322.7  2109.8   331.5  2109.4   335.7  2109.2   343.4  2108.6     352
GR2106.9   366.7  2106.7   375.7  2106.7   381.5    2107   384.3  2107.3   385.8
GR2108.6   390.3    2108   391.6  2108.4   393.1  2109.4   393.2  2108.9   394.5
GR2109.6   394.6  2109.5   396.1  2108.4   397.6  2106.4   397.7  2105.6   399.2
GR2104.6   400.4  2104.5   403.5  2106.4   412.3  2107.2   413.7  2111.7     424
GR2112.1   425.5  2113.7   429.8  2114.5   430.1  2114.9   431.4  2115.8   431.5
GR  2115   432.8  2116.5   432.9  2116.6   434.4    2118   435.8  2117.6   437.1
GR2119.6   437.4  2120.3   438.6  2121.3   438.8  2122.2   440.2  2122.3   441.6
GR2122.6   441.7  2123.5     443    2123   444.4  2123.6   444.5  2123.6     446
GR2127.5   454.1  2127.6   470.6  2132.6   505.3  2133.4   514.6  2133.4   527.3
GR2133.3   531.3  2133.5     532  2133.3   534.8  2133.3     557    2133   566.5
HD42.333      30   244.9   435.8
```

CROSS SECTION #RM142.508

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X142.508      80   187.6   485.2   945.3   945.3   945.3
GR2133.1   165.5  2133.2   172.5  2133.6   174.9    2133   177.2  2133.1   187.6
GR2122.2   217.2  2118.8   227.4  2117.6   233.2  2117.8   233.3  2116.5   240.7
GR2115.9   246.5  2113.9   261.1  2114.1   261.2    2112   275.8  2111.7   277.3
GR2111.3   281.7  2108.7   300.8  2105.1   322.9  2104.4   324.4  2104.5   327.3
GR  2104   328.7  2104.6   330.2  2104.9   330.3  2104.5   331.5  2104.8   331.7
GR2104.7   333.1    2105   333.3  2104.2     336  2104.3   337.5  2104.4   337.6
GR2103.8   338.9  2104.1   339.1  2103.5   346.1  2103.4   352.2  2102.6   353.7
GR2103.2   353.8  2102.7   355.3  2103.2   356.6  2102.6   358.1  2103.3   359.6
GR2102.9   360.9  2103.5   361.1  2103.5   362.4  2103.8   362.6  2103.5   363.9
GR2103.3   369.7  2103.6   369.8  2103.4   371.2  2103.9     377  2103.9   383.1
GR  2104   384.7  2105.4   390.4  2105.8   390.5    2109   397.5  2109.5   397.7
GR  2112   402.1  2113.2   403.5  2114.9   406.4  2116.9   409.2  2117.5   409.3
GR2118.2   410.7  2118.8   410.9    2119   412.2  2118.6   412.4  2119.5   413.8
GR2127.4   472.1  2131.7   481.1    2132   485.2  2131.9     489  2131.7   491.7
GR  2132   499.1  2131.9   501.7  2132.6   510.6  2132.6   514.5  2132.8     520
GR2132.7   541.9  2132.5   542.1  2132.6     550  2132.4     551  2132.6   551.6
HD42.508      30   227.4   413.8
```

CROSS SECTION #RM142.707

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X142.707      80   288.9   623.4  1074.7  1074.7  1074.7
GR2133.3     197  2133.3   216.6  2133.1     218  2133.9   264.7  2133.7   265.7
GR2133.9   288.9    2134   289.8    2131   298.6  2131.1   299.1  2120.5   338.8
GR  2120   339.3  2119.5   340.4  2118.3   344.9  2117.6   347.7  2117.9   348.1
GR2116.8   350.6  2115.5   361.2  2114.8   365.3  2113.9   374.8  2113.5     377
GR2113.1   381.5  2111.6   396.2  2110.2   414.1  2108.8   427.6  2107.2     436
GR  2107   437.8    2106   440.5  2105.2   443.9  2104.1   451.1  2102.5   462.6
GR2100.5   482.7  2100.7   483.2  2100.3   487.9  2099.2   494.7  2099.2   497.9
GR2099.6   502.4  2100.1   506.5  2103.5   524.3  2104.5   525.7    2104   526.1
GR2106.9   528.6  2106.4     529    2108     530  2107.6   530.4  2110.7   532.9
GR2109.9   533.3  2111.5   534.5  2111.4   534.9  2113.2   535.8  2112.6   536.3
GR2114.2   537.4  2113.9   537.9  2115.2   540.1  2115.1   540.8  2115.6   541.9
GR2116.2   542.4  2116.8   543.5  2117.3   544.7  2117.2   545.3  2117.7   546.5
GR2119.1   547.6  2118.3   548.2  2120.8   550.5  2120.5     551    2129   606.3
GR2129.9   606.8  2129.8   607.6  2131.7   623.4  2131.4   634.7    2131   637.9
GR2131.4   646.1  2130.7   654.7  2130.4   696.9  2130.5   699.6  2130.2   709.3
GR2129.8   717.7    2130   718.6  2130.2     731    2130   731.7  2129.9   734.4
HD42.707      30   344.9   546.5
```

CROSS SECTION #RM142.884

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X142.884      80  2773.7  3102.6   950.2   950.2   950.2
GR2133.2  2595.7  2133.1  2604.5  2133.6  2636.4  2133.7  2678.7  2133.5  2688.9
GR2133.8  2689.3  2134.3  2773.7  2133.3  2792.6  2121.4  2831.2    2122  2831.6
GR2122.4  2832.3  2121.1    2836  2120.2  2836.6  2119.6  2838.8  2119.1  2839.2
GR2117.5  2844.8  2116.9  2845.4  2117.1  2845.6  2116.7  2848.5  2116.8  2848.9
GR2116.3  2849.3  2116.6  2851.1  2116.2  2851.8  2115.5  2852.2  2115.2  2858.1
GR2114.6  2859.2    2115  2859.8  2114.3    2862  2114.5  2862.9  2113.8  2865.9
GR  2113  2872.5  2112.4  2874.4  2109.5    2899  2107.2  2920.8  2107.2  2921.8
GR2106.6  2927.7  2106.9  2929.4  2106.4    2931  2106.7  2932.7  2106.2  2934.3
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GR2106.4  2935.3  2104.5    2952    2104  2975.2  2104.2  2978.1  2103.9  2978.7
GR2104.9  2980.7  2104.2  2981.8  2105.1  2991.8  2105.4  2998.4  2105.4  3001.7
GR2105.1  3001.9  2106.8  3011.3  2108.8  3018.3  2113.6  3028.4  2115.2  3030.4
GR2115.4    3031  2115.2  3031.2    2116  3031.7  2116.9  3033.7  2117.2  3034.9
GR2118.3  3036.8  2117.9  3037.2  2118.4  3038.2  2118.8  3040.1  2119.7  3040.5
GR2120.4  3041.5  2119.6  3041.9    2134  3086.2  2135.9  3102.6  2134.9  3107.4
GR2132.4  3111.9  2131.9  3116.4  2131.8  3119.7  2136.4  3220.9  2134.6  3225.6
GR2134.3  3237.4  2133.7  3244.9  2134.3  3247.1  2133.1  3256.9  2132.6  3258.8
HD42.884      30  2844.8  3036.8
```

CROSS SECTION #RM143.122

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X143.122      80   214.9   515.8  1305.7  1305.7  1305.7
GR2133.5   135.6  2132.9     166  2132.3   173.7  2132.6   173.8  2132.3   186.1
GR2131.6   190.1  2131.9   195.9  2132.3   196.5  2132.1   197.7  2133.1   214.9
GR  2133   215.8  2123.3     241  2122.7   241.3  2121.8   245.7    2122   245.8
GR2121.5     246  2120.4   248.4  2120.5   250.3  2119.8   250.5  2118.4   255.2
GR2115.5   262.3  2108.8   275.8  2109.2   276.1  2108.1   278.3  2108.5   278.4
GR2107.5   280.4  2106.8   292.2  2107.4   308.3  2107.4   313.4  2107.6   326.9
GR2107.8   327.1  2108.2   331.5  2108.5   331.7  2108.5   343.1  2108.4   345.7
GR2108.4   364.1  2108.5   366.6  2108.5     399  2108.6   417.5  2108.4   417.8
GR2108.1   424.5  2107.8   424.9  2107.9   428.9  2107.4   429.5  2107.8   431.3
GR2107.4   431.6  2107.5     436  2107.1   436.2  2107.5   438.4  2106.8   438.7
GR2106.9     443  2106.5   443.3  2106.5   450.3  2107.7   454.8  2108.6   457.1
GR2112.1   463.9  2112.4     464  2115.5   470.7  2116.8   471.1  2117.2   473.2
GR2118.5   473.5  2118.7   475.3  2119.7   477.8  2120.7     478  2122.4   478.1
GR2121.9   480.2  2123.4   480.4  2124.2   482.7  2127.3   508.2  2130.4   510.3
GR2131.2     513    2131   514.6  2132.1   515.8  2131.1   529.6  2131.7   533.4
GR2130.2   561.7  2130.9   562.3  2130.8   567.8  2131.1   573.4  2130.6   578.3
HD43.122      30   262.3   470.7
```

CROSS SECTION #RM143.275

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X143.275      55   149.9   427.2   846.4   846.4   846.4
GR2141.3   149.9  2120.5   185.7  2120.2   189.3  2118.5   191.3  2108.5   212.9
GR2098.2   240.7  2098.3   241.1  2093.2   254.3  2091.2   266.3  2090.4   276.4
GR2092.3   299.7  2094.5   306.2  2094.1   307.2  2097.3   313.3  2102.4   330.4
GR2103.2   331.8  2104.4   337.5  2102.9   338.5  2102.9   338.9  2100.1   341.1
GR2098.1   343.6  2097.4   348.6  2097.6   349.2  2098.5   350.7  2100.6   352.7
GR2100.7   353.7  2101.8   354.8  2103.5   355.3  2104.6   357.4  2106.1   357.8
GR2108.5   366.8  2105.9   367.8  2105.6   369.8  2104.5   371.8  2097.4   373.9
GR2094.7   374.3  2086.2     376    2086   376.9  2089.3   378.4  2088.3   379.5
GR2090.5   380.5  2095.4   381.5  2095.3   383.1  2094.5   383.9  2102.2   386.1
GR2104.8   388.1  2107.1   388.7  2107.9   390.7  2107.4   392.1  2111.7     396
GR  2134   427.2  2134.6     433  2134.7   450.4  2134.1   462.7  2134.3   476.3
HD43.275      30   212.9   396.0
```

CROSS SECTION #RM143.414

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X143.414      80  1225.3  1557.4   768.2   768.2   768.2
GR2131.2  1034.6  2131.6  1105.6  2131.5  1153.1  2132.5  1184.4  2132.9  1225.3
GR2132.4  1238.5  2130.7  1248.4  2129.9  1249.8  2129.6  1253.1    2128  1256.6
GR2120.9  1277.2  2115.1  1287.2  2113.8  1290.3  2111.2  1293.6    2112  1293.8
GR2109.8  1296.9  2110.2  1297.1  2105.8  1306.8  2105.9    1307  2104.6  1310.1
```

```
GR2102.8  1316.6  2102.2  1319.9  2101.6    1330  2100.1  1336.2  2100.4  1336.4
GR2098.7  1342.8  2096.6  1352.6  2096.7  1352.9  2095.2    1366  2095.3  1372.2
GR2096.2  1372.4  2095.8  1372.6  2095.7  1375.5  2096.5  1375.7  2095.9  1378.8
GR2096.6    1379  2095.9  1382.1  2096.8  1382.3    2096  1385.6  2096.3  1388.9
GR2098.5  1398.5  2098.1  1398.7    2104  1424.9  2103.8  1425.1  2104.5  1428.1
GR2105.6  1428.3  2108.2    1438    2111  1457.6  2112.8    1474  2114.2  1480.8
GR2117.5  1490.5  2119.3  1497.3  2120.3  1500.3  2131.1  1545.8  2133.5  1557.4
GR2132.9  1570.6  2132.2  1593.6  2132.6  1617.8  2132.2  1618.2  2132.8  1627.7
GR2132.5  1644.1  2133.4  1668.8  2133.8  1675.4  2134.1    1677  2133.9  1690.4
GR2133.5  1693.6  2132.9  1701.7  2133.5  1703.2    2133  1703.6  2133.2  1706.8
GR2132.9  1737.7  2133.4  1747.6  2132.8  1750.9  2133.4  1770.6  2132.6  1777.4
GR2132.8  1779.2  2133.1  1800.5  2132.7  1801.9  2131.8    1833  2131.6  1854.2
HD43.414      30  1287.2  1480.8
```

CROSS SECTION #RM143.564

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X143.564      80   122.5   438.4   834.9   834.9   834.9
GR2133.7       0  2131.5    88.4  2130.1    95.6  2129.9   100.1  2130.1   106.9
GR2131.1   114.5  2131.1   116.1  2132.6   118.6  2132.6   122.5  2128.1   130.9
GR2124.6   134.9  2124.4   141.3  2123.1   144.8  2122.7     145  2120.4   151.6
GR2120.6   151.8  2119.5   154.6  2119.9   154.8    2120     155  2118.6   157.8
GR2119.1   157.9  2116.3   164.6  2117.2   164.8  2114.9   167.6  2115.4   167.7
GR2115.6   167.9  2113.4   177.6  2113.3   177.7  2112.8   180.8  2112.6   187.6
GR2112.6     191  2112.4     194  2112.3   200.7  2111.4   220.2  2110.5   237.1
GR2110.3   243.3  2110.1   243.6  2109.9   249.9  2109.7   250.3  2108.5   269.4
GR2107.3   289.5  2107.1   295.7  2106.8     296  2106.3   305.8  2105.7   312.5
GR2105.5   312.7  2104.2   328.9  2103.4   335.2  2103.2   338.7  2103.5   338.9
GR2103.5   341.9  2103.8     342  2104.1   342.2    2104     345  2104.3   345.2
GR2104.9   345.4  2104.6   348.2  2105.2   348.7  2105.3   351.8    2106   355.4
GR2107.1   358.5  2108.7   361.5  2108.6   361.7  2109.3     362  2111.7     368
GR2112.9   368.5  2113.5   371.3    2114   371.5  2114.7   371.7  2115.5   374.5
GR2116.3     375  2122.3   388.3  2128.1   394.7    2136   438.4  2134.2   449.5
GR2135.3     457  2132.9   463.9  2133.7   466.8  2135.7   486.9  2135.4     489
HD43.564      30   164.6   375.0
```

CROSS SECTION #RM143.821

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X143.821      80  2131.5  2466.7  1422.7  1422.7  1422.7
GR2132.7  1934.7  2132.9  1974.2  2132.6  1975.6  2132.3  1976.1  2132.3  1978.9
GR2131.9  1984.1  2132.4  1993.9  2132.7  2059.8  2132.5  2072.3  2132.9    2076
GR2132.6  2079.1  2132.6  2082.4  2133.3  2087.3  2132.8  2087.5  2133.6  2093.9
GR2134.2  2097.4  2133.2  2107.3  2134.7  2110.6  2134.3  2113.8  2135.5  2120.2
GR2135.1  2124.9  2135.7    2127    2135  2130.3  2135.8  2131.5  2122.7  2182.5
GR2122.8  2182.7  2120.4  2185.8  2120.8    2186  2118.5  2189.1  2118.9  2189.3
GR2116.8  2192.4  2113.2  2199.2  2110.3  2205.6  2110.6  2205.8  2109.8  2208.9
GR  2110  2209.1  2109.8  2212.1  2110.1  2218.9  2109.7  2221.8    2110  2222.2
GR2109.7  2225.1  2109.9  2225.5  2109.2  2248.1  2109.3  2248.3  2108.8  2264.6
GR2108.8  2267.9  2108.1  2297.5  2108.1    2301  2107.8  2310.7  2107.9  2320.5
GR  2107  2349.9  2107.3  2350.1  2107.1  2359.8  2106.7    2360  2106.7  2363.3
GR2106.4  2366.6  2106.4  2369.9  2106.9  2373.2  2107.9  2376.3  2117.5  2392.7
GR2119.3    2396  2120.9  2399.3  2130.7  2422.5  2128.8  2424.2  2133.6  2440.4
GR2133.2  2447.4  2133.4  2450.5  2133.1  2451.9    2134  2453.6  2134.5  2455.2
GR2133.4  2457.1  2135.4    2460  2135.8  2465.3  2136.1  2466.7  2135.3  2481.5
GR2133.5  2486.5  2134.1  2489.8  2131.9  2502.7  2130.8  2512.6  2130.5  2537.5
HD43.821      30  2192.4  2392.7
```

CROSS SECTION #RM144.001

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X144.001      80   651.4   956.3     996     996     996
GR  2132   541.6  2132.3   543.4  2132.2   556.5  2132.6   563.8  2132.1   569.9
GR2132.9   596.1  2132.8   597.9  2135.9   651.4  2122.9   694.8  2122.4   695.9
GR2121.9   696.3  2121.6     698  2121.3   698.4  2119.9   699.5  2119.5   701.4
GR2118.2   702.7  2117.1   704.4  2116.7   705.6  2116.2     706  2112.9   711.5
GR2112.1   712.4    2109   718.3    2107   724.4  2107.1   724.9  2106.9   725.9
GR2106.3   727.6  2106.3   729.1  2106.1   732.5  2107.2   739.5  2107.8     752
GR2108.1   752.8  2107.8   754.5    2108   755.1  2108.1   762.6  2108.2   765.3
GR2109.1   771.9  2109.5   772.9  2109.6   778.2  2109.5   784.8  2109.7   792.4
GR2109.7   795.6  2110.5   818.8  2111.1   834.5  2111.4   844.9  2112.1   864.1
GR  2112   865.2  2112.4   878.7  2112.6   879.2  2112.6   881.3  2114.1   887.2
GR2115.9   890.6  2116.2   892.7  2117.5   895.3  2117.3   895.9    2118   897.6
GR2119.3     898  2117.7   899.3  2133.1   938.2  2133.6   938.3  2134.4   943.5
GR2135.1   945.4  2135.3   954.1  2135.7   956.3  2135.8     986  2135.3   991.7
GR2135.9   993.9  2136.6   998.8    2136  1007.2  2134.2  1015.3  2135.1  1016.3
GR2134.9  1022.3  2135.7  1025.4  2135.1  1025.9    2133  1026.9  2135.7  1028.9
GR2135.6  1030.7  2134.4  1035.8  2135.6  1046.2  2134.9  1049.2  2135.3    1054
HD44.001      30   702.7   895.3
```

CROSS SECTION #RM144.180

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X144.180      80  1848.7  2195.4  1002.3  1002.3  1002.3
GR2132.9    1740    2133  1766.6  2132.7  1766.8  2133.2  1770.1  2133.5  1782.9
GR2132.4  1788.2  2133.5  1791.1  2133.9  1807.8  2133.9    1814  2133.6  1822.6
GR2134.1  1833.7  2134.5  1835.6  2134.1  1848.5  2134.7  1848.7  2133.8  1856.8
GR2119.2    1901  2119.4  1901.2  2118.1  1904.3  2117.8  1904.5  2117.4  1907.6
GR2116.9  1907.8  2116.7  1910.9    2116  1911.1    2115  1914.2  2114.8  1914.4
GR2113.4  1917.5  2113.6  1917.7    2111  1920.8  2111.4    1921  2108.4  1924.1
GR2109.1  1924.3    2107  1927.4  2106.7  1927.6  2105.5  1930.7    2105  1930.9
GR2104.3    1934  2103.6  1934.2    2102  1940.6  2101.6  1943.9  2101.7  1950.4
GR2102.9  1960.1  2103.3  1960.3  2104.6    1970    2105  1970.2    2105  1973.3
GR2105.5  1973.5  2106.7  1983.4  2107.4  1986.7  2107.7  1989.8  2107.9    1990
GR2108.6    1993  2109.6  1999.6  2110.1    2006  2111.6  2019.2  2115.3  2058.5
GR2115.4  2061.8  2117.1  2081.6  2117.6  2084.9  2117.9  2085.1  2118.9  2088.2
GR2118.8  2088.4  2121.4  2094.7  2121.3  2094.9  2122.3    2098  2122.1  2098.2
GR2133.6  2195.4  2132.4  2196.8  2133.1  2200.4  2133.3  2200.7  2133.1  2200.8
GR2133.2  2206.5    2133  2235.1  2133.3    2299  2132.5  2310.7  2132.8    2314
GR2133.2  2334.9  2132.9  2343.2    2133    2363  2132.7  2394.7  2132.4  2396.2
HD44.180      30  1904.3  2088.2
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CROSS SECTION #RM144.464

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X144.464      80   130.3   438.7    1594    1594    1594
GR2134.3       0  2135.3    16.3  2134.2    38.4  2134.6    65.6  2132.7   102.6
GR2133.4   130.3  2132.9   140.5  2131.3   143.6  2122.8   181.7  2121.5   182.4
GR2123.3   183.2  2122.9   184.1  2123.2     191  2119.4   197.5  2118.4   199.8
GR2115.9   202.1  2105.4   218.1  2104.1   218.9  2105.4   219.8  2104.9   220.5
GR2102.3   222.2  2103.4   222.9    2103   223.7  2100.3   225.3  2101.6     226
GR2099.8   227.7  2098.2   228.5  2097.5   229.2  2099.1     230  2097.1   231.5
GR2096.6   232.3  2098.1   233.2  2097.3   233.9  2096.4   235.5  2097.8   236.5
GR  2097   238.1  2098.1   247.6  2097.3   249.2  2099.7     250  2097.7   251.5
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GR2100.9   252.4  2102.7   253.1  2104.1   254.7  2104.1   256.2  2106.7     257
GR2106.3   257.9  2106.6   265.2    2107   266.8  2106.4   269.9  2106.9   270.7
GR  2107   287.3    2106     308  2105.3   313.5  2105.8   314.3  2105.4   316.7
GR2105.8   317.7  2105.2     328  2105.8   336.7  2105.6   345.6  2104.3   353.5
GR2104.1   360.6  2104.4   362.2    2104   364.5  2104.8   365.3  2104.6   367.7
GR2106.9   372.6  2106.9   374.2  2108.1     375  2108.6   377.4  2112.9   384.4
GR2113.9   385.3  2117.7   391.6    2119   392.3  2120.3   394.7  2121.2   395.4
GR2124.3   403.6  2134.4   438.7  2134.9   469.5  2133.5   549.2  2133.5   572.2
HD44.464      30   202.1   391.6

   CROSS SECTION #RM144.676
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X144.676      80   137.7   460.4  1185.6  1185.6  1185.6
GR2132.4    85.1  2132.7   137.7  2120.4   201.4  2122.3   202.2  2124.1   202.6
GR2121.4   204.7  2121.8   205.1  2123.2   205.5  2123.8   205.9  2121.4   207.9
GR2122.9     209  2120.8     211  2121.1   212.3  2119.6   215.8  2117.8   221.4
GR2116.8   222.6    2117   224.7  2116.2   225.4  2115.8   228.3    2116   231.1
GR2115.4   232.3  2115.5   234.2    2115     235    2115   237.5  2114.4   238.7
GR2113.4   248.3  2112.6   261.6  2110.7   284.4  2109.1   300.4  2107.5   313.7
GR2107.7     315  2106.5   330.4  2105.9   331.7  2105.2   336.9  2104.3   338.1
GR2104.3   340.6  2103.5   341.3  2103.5   343.4  2102.6   344.5  2102.3   347.2
GR2101.1   353.3  2101.5   354.4  2101.5   356.5  2104.4   367.8  2105.5   369.7
GR2105.4   370.7  2108.6   376.5  2109.3   377.3    2110   377.6  2110.4   379.8
GR2112.5   380.9    2112     383    2114   383.8  2116.2   384.5  2114.9   386.7
GR2117.3   387.4    2118   387.8  2116.9   389.8    2120   391.1    2119   393.1
GR2120.7   393.5  2121.5   394.2  2121.7   396.3  2122.9   397.1  2122.6   397.5
GR2122.8   399.5  2123.4   399.9    2124   403.8  2128.9   414.3  2129.5   420.7
GR2130.6   424.8  2131.5   425.7  2132.7   452.6  2132.1   453.6  2132.4   453.8
GR  2132   456.7  2133.1   460.4  2131.7   526.7  2131.3   529.1    2131   581.6
HD44.676      30   222.6   389.8

   CROSS SECTION #RM144.840
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X144.840      80     149   475.5   919.7   919.7   919.7
GR2133.5       0  2133.3      21  2133.7    37.1  2133.3    64.9  2132.5    76.2
GR2132.6   105.9    2133   129.5  2132.5   130.1  2133.2   138.4  2133.4     149
GR  2131   160.6  2123.2   202.2  2123.3   202.6  2121.4   205.9  2120.8   206.1
GR2118.2   212.1  2118.4   212.3  2117.3   212.5  2117.1   215.6  2116.3   215.9
GR2115.8   221.9  2115.4   222.5  2115.8   225.7  2115.9   228.7  2115.9   232.1
GR2115.7   238.3    2116   241.8  2116.9   244.7  2116.6   245.2  2115.8   254.9
GR2115.7   258.2  2115.7   261.8  2116.2   268.4  2115.3   275.2  2114.6   284.6
GR2114.4   284.9  2113.4   291.6  2112.8   300.8  2112.7   303.9  2112.7   314.3
GR2112.8   314.5  2112.2   333.6    2112   337.7  2112.1   347.4  2111.2   363.1
GR2110.9   363.9    2111     370  2110.6   370.4  2110.7   376.6  2110.2   376.8
GR2110.1   377.1  2110.1   386.6  2109.8   389.6  2109.8   399.7  2108.3   409.6
GR2108.9     410  2108.6   412.5    2109   412.9  2110.4   419.3  2110.9   419.7
GR2113.1   425.8  2114.8   428.9  2114.7   429.5  2116.5   432.5  2116.1   432.9
GR2118.2   435.5  2118.1   435.8  2117.6   436.2  2119.9   438.7  2119.3   439.5
GR2121.5     442  2121.2   442.4    2123   446.2  2130.8   447.9  2134.1   475.5
GR2133.6   479.6  2133.6   523.5  2133.9   553.2  2133.4   560.5  2133.5   611.5
HD44.840      30   212.5   432.5

   CROSS SECTION #RM144.994
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
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X144.994      80   160.5   466.6   866.4   866.4   866.4
GR2133.7    87.3  2134.3    94.8  2134.3   118.8  2134.1   126.6  2134.4   138.4
GR  2134   138.7  2134.1   147.9  2134.1   160.5  2133.2   168.2  2130.6   174.9
GR2130.4   177.2  2128.7   184.3  2128.5   187.5  2119.5   220.5  2118.7   220.7
GR2113.4   236.2  2111.2   244.1  2107.2   257.1  2106.1   260.2    2101   271.6
GR2099.1   275.6  2097.7   279.4  2097.2   279.9  2096.1   283.9  2094.8     287
GR2091.9   297.2  2088.7   309.8  2088.5     312  2086.9   317.3  2087.1   318.1
GR2086.2   320.4  2084.3   330.6  2083.7   336.9    2084   337.9  2084.6   347.3
GR2084.2   349.5  2084.8   350.3  2084.5   351.4  2085.4   355.6  2086.5   358.7
GR2089.1   362.8  2091.6   365.9  2093.1   366.9  2092.3     367  2094.1     368
GR2094.9   370.3    2096   371.2  2095.3   371.4  2096.6   372.2  2097.1   373.3
GR2097.9   374.1  2097.6   374.5  2098.7   375.2  2099.1   376.5  2102.9   381.4
GR2102.4   381.8  2103.7   382.6    2104   383.7  2104.9   384.4  2104.5   384.8
GR2105.6   385.6  2106.6   387.9  2107.7   388.6  2114.2     399    2115   399.5
GR2116.8   402.5  2117.7   403.3  2120.3   408.6  2120.2   409.4  2121.6   409.8
GR2131.9   451.6  2132.5   451.8  2133.6   456.7  2133.6   459.1    2134   466.6
GR2133.7   483.3    2134   509.5  2133.7   550.7  2132.7   587.2  2133.3   608.3
HD44.994      30   244.1   388.6

   CROSS SECTION #RM145.123
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X145.123      80  2947.1  3241.2   732.8   732.8   732.8
GR2133.3  2631.9  2132.9  2646.9  2133.3  2656.7  2133.1  2746.8    2133  2753.5
GR2132.7    2755  2133.3  2758.5  2132.8  2761.5  2133.1  2761.7    2133  2784.7
GR2133.4  2799.7  2133.3  2830.4  2133.6  2853.6  2133.3  2855.2  2133.9  2868.6
GR2133.9  2888.1  2134.7  2912.9  2134.6  2947.1  2134.8  2947.3  2132.4  2955.5
GR2129.5  2960.2    2129  2961.9  2127.2  2963.3  2128.7  2963.5  2129.5  2968.4
GR2127.3  2970.3  2130.6  2970.5  2121.6  2995.1  2121.1  2995.5  2119.2  2995.9
GR2119.1  2998.4  2117.5    2999  2116.2  3001.7  2115.8  3001.9  2113.8  3005.1
GR2110.4  3012.1  2107.3  3021.3  2105.9  3028.1  2106.2  3028.7  2105.9  3034.7
GR2106.1  3035.3  2106.7  3051.3  2106.7  3054.8  2107.2  3064.6  2108.4  3074.5
GR  2109  3075.1  2109.4    3081  2109.7  3081.6  2109.7  3093.7  2110.1  3094.6
GR2110.1  3097.2  2110.3  3097.8  2111.3  3110.8  2111.6  3111.2  2111.5  3116.9
GR2111.9  3117.7  2112.1  3133.5    2113  3146.8  2113.3  3156.9  2114.1    3170
GR2114.4  3173.1  2115.2  3176.6  2117.5  3183.1  2118.5  3183.3  2118.9  3186.4
GR2119.7  3186.6    2134  3241.2  2134.2  3245.9    2133  3262.5  2132.9  3269.1
GR2134.5  3293.5  2135.2  3293.7  2134.8  3298.8  2135.6  3313.4  2134.3  3382.3
GR2135.1    3389  2135.3  3415.1  2135.8  3426.5  2135.3  3433.1  2135.1  3441.5
HD45.123      30  3001.9  3183.1

   CROSS SECTION #RM145.361
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X145.361      80   420.5     695    1361    1361    1361
GR2134.2   344.4  2134.7   359.5  2134.7   393.6  2134.6   405.3  2134.4   405.6
GR2134.4   420.5  2132.6     430  2127.5   430.2  2118.5   482.8  2116.7   484.1
GR2117.2   484.3  2116.5   485.7  2115.8   485.8  2114.7   487.2    2113   488.5
GR2111.9   490.1  2112.7   490.3  2110.5   491.4    2111   491.6    2106   498.9
GR2105.4   500.3  2105.8   500.5  2104.9   501.6  2103.9   503.2  2104.3   503.4
GR2103.3   504.7    2102   507.6  2101.3   510.5  2100.5   518.2  2099.2   525.1
GR2099.1   529.8  2099.3   531.3    2099   532.6  2099.4   532.7    2099   535.5
GR2099.5   537.1  2099.5   541.5  2099.8   541.6    2102   547.5  2101.9   548.6
GR2102.4   548.9  2102.4   551.7  2102.9   553.3    2103   554.6    2104   556.2
GR2106.4   572.1  2106.6     575  2106.9   575.3  2106.9   577.9  2109.8   595.7
GR  2111   604.5  2112.9   616.3  2114.9   623.6  2115.5   624.9  2116.1   625.1
GR2116.7   626.5  2116.5   626.7  2118.4     628    2119   629.4  2118.3   629.6
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GR2120.6   630.9  2120.3   632.2  2120.8   632.4  2122.2     634    2122   635.3
GR2123.5   636.9  2122.4   637.1  2124.3   638.4  2124.2     640  2133.4     695
GR2132.5   706.1    2133   743.8  2132.5   808.5  2133.4   897.7  2133.2   936.3
GR2134.8  1026.9    2136  1039.6  2135.5  1049.6  2135.9  1053.4  2135.5  1056.2
HD45.361      30   485.8   623.6
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CROSS SECTION #RM145.565

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X145.565      80   139.5   444.6    1166    1166    1166
GR2133.6   117.9    2134   139.5  2130.5   152.9  2129.6     154  2129.7     157
GR2128.5   158.8  2129.6   159.3  2122.2   201.5  2121.9   201.7  2120.7   201.9
GR2121.2   204.7  2119.5   205.2  2120.2   207.7  2118.4   208.4  2119.1   210.8
GR2118.1   211.4  2117.4   211.6  2117.8   214.1  2117.2   214.6  2116.5   214.9
GR2116.7   217.4  2115.9   217.9  2112.1   227.6  2111.3   228.1  2111.1   230.5
GR2110.3   231.2    2109   237.4  2108.6   237.8  2106.3   251.2    2105   260.3
GR2104.5     261  2104.2   263.8  2103.7   264.2  2103.3   266.7  2102.8   267.2
GR2100.8   273.2  2098.8   277.2  2096.4   283.6  2093.8   287.5  2093.5   290.2
GR2093.5   293.8  2093.9   296.9  2095.7   303.2  2095.3   303.9    2097   309.8
GR2097.5   310.1  2097.6   312.9  2098.4   313.4  2098.3   316.3    2099   316.8
GR2098.6   319.6  2099.1   320.1  2098.7   332.8  2099.4   333.5  2102.2     346
GR2102.8   346.4  2103.2     349  2103.7   349.7  2105.7   355.7  2107.4   359.5
GR2108.1   359.7  2108.4   362.2  2109.1   362.6  2113.4   372.6  2115.2   376.1
GR2117.4   378.6  2117.2   379.1  2119.6     382  2120.1   382.2  2119.7   382.4
GR2120.9   382.6  2121.9   385.4  2122.8   386.1  2133.9   430.7  2134.4   444.6
GR2133.4   449.4  2133.6   466.3  2133.1   470.3  2133.7   472.5  2133.4   473.3
HD45.565      30   217.9   378.6
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CROSS SECTION #RM145.745

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X145.745      80     289   587.3  1034.1  1034.1  1034.1
GR2136.5   144.8  2137.4   145.6  2137.8   160.3  2137.4   171.2  2135.8   173.4
GR2135.3   177.3  2133.3     182    2134   183.7  2133.3   185.4  2131.8   210.1
GR2131.4   210.6  2131.9   220.6  2132.2     239    2132     271  2132.6     289
GR2128.9   302.3  2129.7   302.4  2117.8   337.8  2118.8     339  2115.8   340.5
GR2117.5   341.5  2114.5     343  2115.1   343.5  2113.1   344.9  2113.7   346.1
GR2110.4   347.6    2112   348.3  2112.1   348.6  2109.3   349.8  2110.7   350.8
GR2107.8   352.3  2109.1   353.2  2106.2   354.4  2107.9   355.4  2105.6   356.9
GR2106.3   357.4  2106.5   357.9  2104.5   359.6  2104.7   360.1  2103.5   364.7
GR2102.8   366.2  2103.2   367.4  2102.3   368.6  2100.7   378.5  2099.9   378.9
GR2100.1   380.4  2098.1     387  2098.6   388.2  2097.8   389.7  2098.9   390.7
GR2097.8   391.6  2098.8   392.6  2098.1   394.1  2098.8   395.3  2098.2   396.8
GR2097.9   406.6  2098.3   407.1  2098.1   408.7  2099.3   411.8  2100.5   420.3
GR2102.2   427.1  2103.8   430.3  2105.4   436.2  2107.7   446.2    2109   455.3
GR2110.1   467.7  2110.6   469.2  2111.9   469.5  2113.8   472.2  2115.9     490
GR  2118   516.9  2119.1     525  2120.5   532.1  2121.8   541.4  2122.5   544.6
GR2122.4   545.1  2134.4   587.3  2132.6   602.8  2131.1   643.3  2131.4     652
HD45.745      30   337.8   525.0
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CROSS SECTION #RM145.921

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X145.921      80   135.8     440  1003.9  1003.9  1003.9
GR2133.4    84.1    2135    91.8  2133.3   101.5  2134.6   102.4  2133.8     107
GR  2133   109.3  2133.9   115.3    2134   123.1  2133.6   135.8  2132.8   136.3
GR2132.9   146.9  2132.7   150.7  2132.4   151.3  2130.1   167.7  2129.7   168.4
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GR  2120   204.5  2117.5   212.4    2117   214.7  2116.4   219.5  2116.1   223.7
GR2115.7   233.2  2114.6   249.9  2112.9     269  2112.7   270.5  2112.5   275.4
GR2107.4   310.4  2107.7     312  2107.3   312.7  2107.4   314.4  2106.3   325.4
GR2105.9   326.1  2105.8     332  2105.1   350.1  2105.6   354.9  2107.1   364.6
GR2106.5   366.2  2107.1   366.8  2106.9   368.5  2106.1   370.1  2106.7   370.8
GR2106.3   373.3  2106.7     374  2106.6   376.4    2107     377  2107.1   379.6
GR2107.7   380.2  2107.6   381.9  2107.8   382.6  2108.5   383.6  2108.4   384.2
GR2108.7     385  2110.2   386.7  2109.6   387.6  2110.3   388.5  2111.6   389.3
GR2112.5   390.1  2111.4   390.7  2112.5   391.7  2115.1   393.1  2113.5   393.8
GR2114.5   394.7    2116   395.5    2117   396.3  2117.7   397.2  2116.7   397.9
GR2119.2   399.6  2119.7   400.3    2119   400.9  2120.5   402.7  2120.8   403.5
GR2120.4   404.1  2122.3   406.5  2121.5   407.4  2122.3   408.1  2122.6   408.9
GR2123.7   409.8  2123.8   410.6  2134.7   436.2  2135.2     440  2134.1     442
HD45.921      30   204.5   404.1
```

CROSS SECTION #RM146.091

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X146.091      80   141.5   387.5   928.8   928.8   928.8
GR2134.1    96.8  2134.1   104.2  2134.2   108.1  2133.9   109.3  2133.1   116.5
GR2133.7   128.8  2133.2   129.1  2133.3   136.1  2133.1   136.8  2133.2   141.5
GR  2120   191.5  2117.9   194.6  2118.3   194.7  2116.1   197.9  2116.3     198
GR2113.1   204.4  2113.6   204.5  2112.2   207.7  2112.5   207.8  2111.6   211.2
GR2111.4   211.3  2110.7   214.4  2110.9   214.5  2109.9   217.7  2110.1   217.8
GR2108.9   224.1  2108.5   227.4  2106.1   240.7  2105.6   243.9    2105   250.5
GR2104.6   253.7  2104.8   253.8  2104.2   260.2  2103.7   263.7  2103.6   263.8
GR2102.1   270.3  2101.1   273.4  2100.2   276.6  2097.9   286.4    2098   286.5
GR2097.1     290  2095.8   293.2  2095.4   296.4  2095.6   296.5  2094.4   302.9
GR2094.5     303  2094.1   306.2  2094.2   306.3  2094.5   309.5  2095.5   312.7
GR2097.2   316.1  2097.1   316.2  2098.9   319.4    2100   322.6  2100.2   322.7
GR2101.3     326  2102.7   329.1  2102.6   329.2  2104.4   332.4  2104.3   332.5
GR2105.8   335.6    2106   335.7  2108.6   338.9  2108.9     339  2111.9   342.4
GR2111.6   342.5  2114.6   345.7  2117.5     349  2119.5   352.2  2119.9   352.3
GR2120.7   355.4    2135   386.7  2137.3   387.5  2135.5     406  2135.1   406.9
GR2135.6   409.1  2135.2   411.9  2134.8   416.8  2134.8   420.9  2135.1   425.3
HD46.091      30   197.9   345.7
```

CROSS SECTION #RM146.270

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X146.270      79   183.5   510.2   936.1   936.1   936.1
GR2134.1   142.4  2135.3     154  2134.1   160.2  2134.9   183.5  2121.2   242.9
GR2120.5   243.8  2121.5   244.7    2121   246.5    2122   247.5  2120.5   248.2
GR2118.8   250.1  2117.8   256.8  2116.7   260.3  2115.4     273  2115.1   279.2
GR2115.4   292.2    2115   303.1  2114.6   308.4    2115   309.4  2114.8   310.3
GR2114.6   323.9  2114.4   325.9  2113.9   336.7  2110.8   378.4  2110.7   385.1
GR2109.8   394.9  2108.9   396.7  2109.1   397.6  2108.7   398.6  2108.2     404
GR2108.5   413.2    2108   418.7  2106.8   421.4  2106.9   423.1  2106.1   424.1
GR2106.5   425.1  2105.6   425.8  2106.9   427.7  2106.2   428.4    2107   429.5
GR2106.4   430.3  2107.1   431.4    2108   432.1  2107.5     433  2108.3     434
GR2107.9   434.9  2108.6     435  2109.5   441.3  2110.2   442.1  2109.9   444.2
GR2110.9   444.9  2110.6   445.9    2112   446.6  2110.7   446.9  2111.6   447.8
GR2111.6   448.8  2113.2   449.5  2113.1   450.6  2113.4   451.4  2114.8   452.2
GR2114.9   453.2  2116.4   454.1  2116.4   455.1  2121.2   461.3  2121.8   463.1
GR2122.6   464.1  2122.2     465  2122.2   465.8  2123.1   466.8  2123.5   467.7
GR2131.1   479.2  2134.3   506.8  2135.9   510.2  2134.9   531.9  2133.9   532.9
GR2134.7   534.4  2134.8   545.6  2135.2   551.4  2135.5   563.3
```

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HD46.270      30   256.8   454.1
```

CROSS SECTION #RM146.453

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X146.453      80   248.2   530.3   957.9   957.9   957.9
GR2134.8   220.2    2135   224.6  2134.9   237.4  2134.5   248.2    2134   251.7
GR2134.1     252  2131.2   263.7  2130.9   264.2  2122.7   301.9  2122.1   302.5
GR2121.3   304.4  2120.6   307.2  2119.1   309.3  2115.1   320.8  2113.9   325.5
GR2112.5   330.1  2111.6   334.7  2111.1     335  2111.1     337  2110.5   337.3
GR2110.3   339.4  2109.7   339.8  2109.9   341.6  2109.3   342.1  2107.9   348.5
GR2107.3     349  2107.4   350.8  2106.9   351.4  2106.7   353.2  2106.2   353.7
GR2105.8   355.8  2105.7   357.8  2105.2   358.3  2104.9   362.4  2104.2   362.9
GR2102.8   369.6  2102.3   369.7  2101.9   371.9  2101.4   372.2  2101.5   374.2
GR2100.4   374.5  2100.5   376.5  2095.4   388.3  2095.1   388.6  2095.4   390.2
GR2094.9   390.6  2091.8   399.8  2091.4   399.9  2091.4     402  2090.9   402.5
GR2090.6   406.6  2090.4     407  2090.8   411.4  2090.5   411.7  2093.7     423
GR  2094   423.3  2098.4   434.6  2100.8   439.4  2104.1   448.9  2105.1   450.9
GR2105.5   451.2    2106   453.3  2108.3   455.4  2109.2   455.8  2111.8   458.1
GR2112.9     460  2113.7   460.2  2113.6   460.5  2117.9   464.8  2119.2   467.7
GR2135.3   523.9  2135.5   530.3  2133.7     546  2133.8   547.7  2133.4   548.8
GR2133.8   549.2  2133.3   550.6  2133.7   569.3  2133.6   579.9  2133.2   584.8
HD46.453      30   325.5   460.2
```

CROSS SECTION #RM146.651

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X146.651      80   363.7     662  1032.8  1032.8  1032.8
GR2133.4   287.6  2138.3   312.9  2137.4   313.1  2138.3   318.3    2137   324.1
GR2134.6   338.8  2134.3   344.3  2135.6   346.4  2134.6   359.1  2135.1   363.7
GR  2130   377.3  2127.6   384.8  2122.8   405.5  2123.2   406.7  2121.4   407.8
GR2121.2   409.9  2120.3     411  2120.6     412  2119.2     414  2119.3   415.1
GR2117.7   419.4  2115.9   423.1  2114.9   424.4  2115.6   425.1  2114.3   425.6
GR  2115   426.3  2113.3   427.4  2112.2   428.6  2112.7   429.3  2110.9   431.7
GR2111.7   432.4  2110.1   432.9    2111   433.6  2109.7   434.7  2107.6   442.2
GR2107.8   442.9  2107.2   443.2  2103.5   452.5    2104   453.2  2102.2   457.7
GR2102.5   458.6  2099.7   465.7  2095.8   480.5  2095.2   481.6    2096   482.3
GR  2095   484.6  2095.4   488.7  2094.5   493.2    2095   493.9  2095.6   496.9
GR  2097   505.6  2104.4   539.7    2105   543.8    2113   585.3  2116.9     603
GR2120.1   613.3  2130.4   650.5  2134.8     662  2135.2   686.6  2134.1   719.6
GR  2135     731  2134.4   747.4  2134.4   776.3  2134.1   777.5  2134.7   780.9
GR2134.3   792.5  2135.4   796.8  2135.2   818.7  2135.4     826  2135.1   828.5
GR2135.5   829.3    2137   842.1  2136.5   845.3  2137.4   848.1    2137   877.7
GR2136.4   883.5  2136.9   884.9  2135.8   889.7    2135   899.5  2135.4   903.6
HD46.651      30   414.0   613.3
```

CROSS SECTION #RM146.816

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X146.816      80  1141.8  1408.5   863.3   863.3   863.3
GR2129.3    1064  2129.9  1064.2  2129.7  1064.8  2130.1  1075.9  2130.6  1082.2
GR2130.3  1082.9  2134.5  1099.1  2134.1  1101.1  2135.3    1102  2136.7  1105.2
GR  2138  1115.1  2135.4    1127  2135.8  1127.2    2134  1131.7  2134.8  1141.8
GR2132.8  1152.9  2119.4  1172.4    2121  1172.8  2117.4  1175.2  2116.3  1175.4
GR2116.8  1177.9  2116.2  1178.5  2114.5  1178.7  2114.8  1179.1  2113.6  1182.4
GR2111.9  1184.7  2111.7  1185.3  2110.9  1185.7    2111    1188  2109.5    1189
GR2107.9  1194.5  2105.3  1201.1  2105.3  1201.7  2104.8  1201.9  2104.2  1207.9
```

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GR2103.2    1211  2103.3  1212.8  2101.8  1214.4  2102.3  1215.9    2101  1217.7
GR2101.5  1219.2  2100.7    1221  2101.3  1221.8    2100  1224.3  2100.6  1225.5
GR2099.3  1227.6  2100.1  1228.8  2098.9  1230.9  2099.3  1231.7  2099.3  1237.6
GR2098.9  1244.2  2099.4  1247.5  2100.9  1254.9  2102.9  1262.5  2105.8  1268.4
GR2106.5  1271.1  2107.4  1278.1  2110.3  1295.1  2111.6  1303.7  2111.9  1308.3
GR2113.5  1310.5  2113.5    1315  2115.1  1326.9  2115.6    1337  2116.3    1344
GR2119.4  1367.6  2121.6  1376.8  2134.4  1408.5  2133.8  1416.7  2133.4  1426.7
GR2133.7  1429.8  2132.6  1440.1  2134.2  1460.4  2133.9  1483.2  2132.2  1492.8
GR2133.6  1502.9  2130.9  1544.1    2131    1555  2130.6    1562  2131.7  1569.8
HD46.816      30  1172.4  1367.6
```

CROSS SECTION #RM147.043

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X147.043      80   224.1   594.2  1189.4  1189.4  1189.4
GR2132.5   193.7    2135   201.5  2136.2   203.5  2135.7   205.7  2138.6   217.1
GR2138.6   224.1  2135.1   242.2  2133.4   243.4  2134.8   245.5  2134.7   254.8
GR2135.7   255.5  2130.6   267.6  2132.4     273  2124.6   311.8  2122.2   313.6
GR2123.6   313.8  2122.2   316.1  2121.1   316.8  2120.9   318.3  2120.3   318.8
GR2119.5   320.8  2118.5   321.4  2117.4   325.3    2117   325.8  2114.2   332.6
GR2112.7   337.9  2110.8   348.9  2111.4   349.2  2110.5   350.9  2111.4   351.7
GR  2110     356    2109   360.3  2107.9   368.1  2108.1   372.3  2109.2   383.6
GR2109.5   390.7  2109.5     414  2109.2   421.5  2110.4   426.1    2111   437.6
GR  2111   449.2  2111.6   458.5  2111.7   465.3  2112.3   465.6  2111.8   467.8
GR2111.7   476.6    2113   477.4  2111.8   481.3  2112.1   481.6  2112.9   481.8
GR2111.9   483.8  2113.5   484.3  2111.9   485.8  2112.1   486.3  2112.8   486.4
GR  2112   488.4  2112.3   488.8  2113.3   488.9  2111.9   490.6  2112.6   491.3
GR  2112   493.1  2112.9   507.7  2112.4     521  2112.6   523.3  2113.6   528.3
GR2115.2   532.6  2119.2   539.9  2120.6   544.1  2121.7   544.7  2122.6   544.9
GR2121.9   546.6    2123   547.2  2122.9   549.2  2123.9   549.7  2123.9   553.7
GR2123.5   554.2  2135.7   594.2    2135   634.1  2135.2   642.2  2134.8   657.2
HD47.043      30   332.6   532.6
```

CROSS SECTION #RM147.231

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X147.231      80   228.1   612.5   993.6   993.6   993.6
GR2133.2   154.2  2134.2   228.1    2134   230.2  2116.7   291.9  2114.8   294.2
GR2113.6   298.8    2114     299  2111.8   301.2  2110.7   303.4  2107.9     308
GR2107.5   310.4  2106.1   312.7  2105.3   312.8  2104.6   317.3    2105   317.4
GR2101.7   326.5  2101.8   326.8  2100.5     329  2100.2   331.3  2100.7   331.4
GR2097.6   338.2  2096.9   340.6    2095   342.8  2095.9     343    2094   345.2
GR2091.6   354.5  2090.4   354.6  2089.7   356.7  2090.4   356.8  2088.9     359
GR2088.1   361.4  2088.5   361.6  2087.2   363.5  2087.8   363.8  2087.2   366.2
GR2086.2   368.4  2086.7   368.6    2083     387  2083.1   389.4  2082.4   391.5
GR2080.9     401  2080.9   410.2  2081.2   412.6  2082.1   417.1  2082.8   417.2
GR2083.3   421.7  2084.2   421.8  2083.8   424.2  2085.3   426.4  2085.7   428.8
GR2086.8     431  2091.6   438.2  2092.2   442.6  2092.7   442.8  2096.5   479.8
GR2098.2   489.2  2101.1     503    2101   503.2  2103.2     510  2102.9   510.1
GR2113.7   537.7  2114.1   537.8  2114.3   540.2  2113.8   540.3  2115.3   542.4
GR2114.7   542.6  2119.3   556.3  2119.5   556.4  2128.4   580.2  2129.9   581.5
GR2134.4   590.1  2135.6   598.4  2136.1   612.5  2135.7   617.9  2136.2   629.3
GR2135.8   630.1  2135.8   657.3  2135.7     666  2135.9   666.8    2135   670.3
HD47.231      30   312.8   510.0
```

CROSS SECTION #RM147.452

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NC .0291   .0291   .0331
```

```
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X147.452      80   144.8   505.9  1166.7  1166.7  1166.7
GR  2131   124.1  2130.9   129.1  2131.6     137  2131.4   137.6  2131.6   139.2
GR2133.7   144.8  2129.3     171  2130.2   177.4  2119.1   238.9  2118.4     241
GR2114.3     250  2112.9   251.7  2112.6   253.4  2111.2   255.1  2110.5   257.8
GR2110.1   258.4  2109.3   262.3  2109.5   266.7  2109.3     268    2109   274.4
GR2110.1   291.8  2110.4   301.3  2110.2   303.4  2110.9     337  2110.6   338.8
GR2110.9   340.2  2110.5     342  2110.9   343.5  2110.7   344.7  2110.7     351
GR2110.3   352.2    2111   353.5  2110.3   355.4  2111.1   356.8  2110.3   358.6
GR  2111   360.2  2110.3   362.1  2110.5   364.1  2108.8     371  2109.2   372.1
GR2108.7   374.3  2110.7     389  2111.1   390.4  2113.2   407.6  2113.6     412
GR2113.4   418.1  2113.8   418.6  2113.9   419.3  2112.6   420.6  2113.5   421.7
GR2113.6   422.4  2112.5   423.9  2113.4   425.1  2113.5   425.6    2112   426.9
GR2111.5   428.9  2111.3   431.4  2111.7   434.6  2112.5   437.8  2117.3   447.6
GR2118.1   448.9  2122.2   457.8    2123     461    2123   461.7  2129.1     476
GR2130.1   477.3  2131.6     478  2131.2   478.3  2132.9   484.9  2132.9   485.6
GR2133.7   487.1    2135     496    2136   505.9  2135.7   506.4  2135.8   510.8
GR2135.6   511.6  2135.9     518  2135.7   525.5  2135.9   536.6  2135.9   558.9
HD47.452      30   250.0   447.6
```

CROSS SECTION #RM147.657

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X147.657      80   136.6   449.7  1080.9  1080.9  1080.9
GR2132.4   105.2  2135.7   136.6    2134   145.7  2134.4   146.7  2134.9   147.3
GR2134.1   148.8    2133   152.5  2133.1     154  2122.9   191.4  2123.5   191.8
GR2122.9     192    2121   198.3  2116.8   208.3  2116.9   208.6  2115.8   211.3
GR2114.8   217.8  2115.1   218.4  2114.6   221.3  2114.8   221.6  2114.4   224.3
GR  2114   237.9  2113.9   244.4  2113.5   250.6  2111.5   273.8  2111.3   277.5
GR2110.6   280.3  2109.3   283.5  2109.5   283.8  2108.9   286.9  2109.4   287.2
GR2108.8   290.1  2109.5   290.5    2110   306.4  2109.6   306.9  2109.7   309.6
GR2109.5     310  2108.9   326.4  2108.2   332.9  2108.3   333.4  2107.2     336
GR2108.1   336.4  2107.4   339.5  2107.9   339.9  2107.3   349.4    2107   349.8
GR2106.6   355.9  2106.3   356.3  2106.2   359.1  2105.9   359.6  2105.1   369.1
GR2104.9   369.5  2104.6   372.5  2104.7   372.9  2103.8   375.6  2103.9   375.8
GR2104.6   376.1  2103.4   378.8  2103.8   379.5  2103.7   382.1  2104.3   382.8
GR2104.8   385.6  2105.3   385.9  2106.3   388.8  2106.7   389.2  2107.8   392.2
GR2109.3   395.7  2109.9   395.9  2111.2   398.5    2111   398.7  2112.7   401.9
GR2117.2   408.7  2120.2   415.2  2119.9   415.4  2121.3   418.3  2121.2   418.8
GR2129.3     433  2129.9   440.5  2135.4   449.7  2135.1   455.4  2135.1   503.7
HD47.547      30   211.3   408.7
```

CROSS SECTION #RM147.881

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X147.881      80   140.8   555.8  1180.5  1180.5  1180.5
GR2131.1   122.5  2131.7     125  2132.5   126.5  2135.8   140.8    2133   161.7
GR2133.2     163  2132.1   170.7  2132.4   170.9  2132.2   175.6  2129.7   182.2
GR2122.4   237.4  2122.4   240.3    2122   246.3  2121.9   250.6  2120.9   262.5
GR2118.7   281.5  2118.4   287.4  2117.7   294.5  2117.2     296  2117.5   296.1
GR2115.6   299.1  2115.1   300.5  2113.9   306.5  2112.9   310.8  2110.8   316.7
GR2109.8   319.7  2109.1     321  2109.3   321.1  2106.8   326.7  2107.3   326.9
GR2106.7   328.3  2107.1   328.4  2106.2   329.8  2106.2   331.2  2105.6   332.6
GR2106.1     333  2105.1   334.1  2105.7   334.5  2105.7   335.8  2104.7   337.3
GR2104.8   340.2  2104.3   341.5  2102.9   350.4  2103.1   357.7  2104.2     374
GR2104.6   378.2  2104.3   379.7  2104.9   379.9  2104.2   382.6  2104.8   384.1
GR2104.2   385.6  2103.5     396  2102.9   413.4  2103.5   419.1  2102.8   419.3
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GR2103.8   420.6  2103.2   420.7  2104.7   426.8  2103.8   426.9  2105.4   429.7
GR2108.7   438.4  2112.7   447.1  2117.2   456.2  2119.2   460.5    2120   463.4
GR2120.5   463.5  2120.6   464.8  2121.4   466.2  2127.6   499.5  2129.6   502.4
GR2130.2     504    2132   519.1  2132.4   533.2    2132   535.8  2132.4   536.6
GR2133.6   555.8  2133.2     583  2133.3   592.8  2132.9   593.8  2131.8   603.6
HD47.881      30   296.0   456.2

   CROSS SECTION #RM148.098
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X148.098      80   615.9   952.6  1160.4  1160.4  1160.4
GR2133.2   498.8  2133.4   503.1  2133.2   505.9  2133.5   549.6  2133.3   551.1
GR2133.9   558.8  2133.8   581.9  2133.3   588.1  2133.5   602.8  2134.7   615.9
GR2134.4   616.2  2119.8   680.3  2119.5     681  2119.7   682.3  2118.4   684.2
GR2116.7   688.6  2116.9   689.1  2115.6   690.6  2112.7   697.8  2112.9   698.8
GR2111.5   700.3  2111.5     702  2110.5   703.5  2110.3   705.4  2109.4   707.4
GR2109.8     709  2108.5   710.7  2108.7   711.8    2109   712.2  2107.8   713.9
GR2107.8   715.4  2106.7   717.1  2106.6   718.4  2102.6   724.6  2100.8   725.8
GR2100.4   727.3  2099.6   729.2    2099   732.4  2099.5   741.5    2102   758.8
GR2102.7   760.3  2102.3   762.4  2103.6   767.3  2103.3     769  2104.1   770.4
GR2103.8   772.2  2104.7   773.7  2107.6   794.3  2107.5   794.9  2109.2     817
GR2108.9   818.5  2109.3   820.6  2109.1   821.7  2109.4   827.2  2109.2   828.9
GR2110.1   842.3  2110.5   844.4  2110.5   845.7  2113.2   861.2  2113.6   862.3
GR2113.7   863.8  2116.8   874.6  2120.1   885.4    2120   886.9  2120.9   888.2
GR2130.3   916.4  2132.1   918.2    2136   939.3  2136.9     949  2136.6   949.2
GR  2137   952.6    2136   986.4    2136  1004.2  2135.8  1005.1  2136.3  1008.5
GR2136.3  1015.3  2135.9  1022.7  2135.9  1052.7  2136.3  1078.2  2136.1  1087.1
HD48.098      30   680.3   862.3

   CROSS SECTION #RM148.320
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X148.320      59   169.2   491.6  1207.6  1207.6  1207.6
GR2134.8     124  2134.7   136.8  2135.6   161.1  2135.7   169.2  2119.9   221.9
GR2116.9   226.9  2115.1   229.6  2114.1   231.7  2112.1   233.4  2108.9   239.8
GR2106.6     250  2105.4     254  2104.3   255.4  2102.7   258.7  2101.5   261.9
GR2100.4     265  2099.4   268.3  2099.1   270.7  2099.9   275.2  2099.8   277.7
GR2100.5     285  2102.3   295.2  2106.4   312.8  2107.5   320.2  2108.4   323.4
GR2108.4   327.2  2108.3   330.4  2108.2   333.5  2107.9   336.8  2107.6   340.9
GR2107.6   344.9    2108   345.5    2108   349.3  2108.1   351.1  2107.3   352.5
GR2106.8   355.7  2106.2   359.5  2108.7   360.6  2109.3   365.3  2109.2   371.1
GR2110.2   378.9  2113.3   392.3  2114.5     402  2114.5   404.6  2114.8   407.6
GR2115.3   410.9  2115.7     414  2116.6   416.2  2117.9   428.3  2118.9   431.6
GR2119.3   432.3  2120.2     433  2133.1   466.8  2133.3   472.1  2134.3   477.5
GR2135.5   491.6  2135.2   512.8  2134.9   529.3  2135.2   532.1
HD48.320      30   231.7   404.6

   CROSS SECTION #RM148.485
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X148.485      80   125.9   503.9   896.4   896.4   896.4
GR2134.8    97.3  2134.8   102.7  2134.4   106.9  2134.8   125.9    2135     126
GR  2134   135.2  2134.1   138.5  2133.9   143.3  2128.7   156.8  2127.8   158.3
GR2123.3   192.1  2121.5   195.3  2121.7   198.5  2122.5   205.3    2123   205.4
GR2122.1   208.6  2120.8   218.3  2120.2   218.4  2118.6   228.1    2119   228.2
GR2117.4   231.5  2118.1   231.7  2115.5     238  2116.7   238.2  2114.1   241.3
GR2114.8   241.4  2112.8   244.5  2115.3   244.7  2111.8   247.7  2112.7   247.8
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GR2114.7   247.9    2112     251  2113.6   251.1  2109.8   254.2  2112.3   254.4
GR  2109   257.7  2111.2   257.9  2107.8   264.2  2108.8   264.4  2106.7   267.5
GR2104.2   274.1  2103.4   277.3  2103.5   280.6  2105.3   293.7  2104.9   293.8
GR2105.1     297  2106.4   303.6  2107.1   316.7  2107.5   316.8  2110.5   339.9
GR2112.5   349.5    2113   356.1  2112.5   356.2  2113.1   359.3  2112.6   359.5
GR2113.1   369.4  2112.2   369.5  2113.2   372.6  2112.1   372.7  2113.4   375.9
GR2112.2     376  2113.5   379.1  2112.5   379.2  2113.9   382.4  2114.8   395.6
GR2113.9   395.7  2115.2   398.8  2116.7   411.9  2117.8   418.7  2120.5   428.4
GR2121.6   431.6  2120.4   431.7  2120.3   434.9  2129.4   447.7  2131.5     459
GR2133.2   483.1  2133.5     496  2134.5   503.9  2134.3   543.7  2134.1   551.1
HD48.485      30   231.5   418.7
```

CROSS SECTION #RM148.696

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X148.696      80   147.7   446.9  1143.5  1143.5  1143.5
GR2135.5   130.9  2134.8   134.7  2136.2   141.1    2136   142.5  2137.1   147.7
GR2136.3   154.2  2133.2   161.4  2133.7   163.5  2121.4   193.2  2119.4   195.8
GR2111.3   207.9  2109.9   213.2  2109.5   216.3  2109.7   222.3  2109.6   226.1
GR2108.9   232.4  2107.9   238.9  2107.4   245.9  2107.6   247.1  2106.6   251.8
GR2107.2   253.8  2106.6     255  2107.2   260.1  2107.7   276.3  2108.3   277.7
GR2107.5   278.8  2108.4   280.8  2107.5   282.1  2108.4     284  2107.4   285.2
GR2108.4   287.3  2107.3   288.4  2108.4   290.4    2108   296.2  2108.4   297.4
GR2107.3   298.6  2107.3   300.6  2106.5     302  2106.6     304  2106.1   305.2
GR2106.2   306.6  2105.8   312.3  2106.5   314.2  2105.9   315.5  2106.5   317.4
GR2106.1   319.3  2106.4   320.6  2106.8   332.9  2105.8   339.9  2106.3   341.3
GR2105.4   342.5  2105.7   343.8  2105.8   349.5  2106.3   350.9  2105.9     352
GR2106.1   352.7  2106.8   362.5  2107.2   363.9  2109.2   372.6  2110.3   381.1
GR2109.8   382.5  2110.6   390.2  2111.9   391.5  2111.5   392.7  2113.1   394.7
GR2113.2     396  2114.7   397.8    2115   399.8  2115.9   400.4  2116.9     403
GR2117.4   403.6  2123.5   416.5  2123.7   417.9  2133.2   431.4  2137.7   446.9
GR2137.5     474  2138.2   475.8  2137.8   477.4  2136.8   495.2  2136.6   516.6
HD48.696      30   208.7   391.5
```

CROSS SECTION #RM148.959

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X148.959      80   158.3   491.3  1427.1  1427.1  1427.1
GR  2137     115  2137.2   130.8  2137.8   131.2  2137.7     138  2136.2   140.7
GR2135.1   144.2  2136.1   146.6  2136.4   149.8  2134.7   151.7  2135.1   156.8
GR2136.6   158.3    2122   212.7  2122.2   212.8  2117.9   222.4  2118.1   222.6
GR  2116   229.4  2115.9   232.6  2116.1   235.4  2115.5   238.8  2115.5   242.4
GR2114.9   245.4  2115.4   245.8  2114.3     252  2115.1   252.3  2113.6   255.1
GR2114.6   255.7  2113.3   258.6  2109.9   275.1  2109.6   278.4    2109   291.6
GR2109.3   304.6  2108.9   317.6  2109.9   317.9  2108.8   320.7    2110   321.1
GR2108.8   324.3  2109.8   324.6  2108.6   327.5  2109.6   327.8  2108.2   330.7
GR2109.4     331  2107.8   333.9  2109.6   334.6  2102.1   373.3  2102.6   373.6
GR2101.5   376.8    2102   376.9  2102.1   377.1  2099.6   386.7  2100.3   386.9
GR2099.3   389.7  2099.8   390.3  2100.3   393.1  2099.8   393.5  2101.1   396.5
GR2102.8   403.1    2102   403.7  2103.6   406.5  2103.2   406.7  2106.6   416.4
GR2106.4   416.7  2108.1   419.5  2107.7     420  2110.6   422.8    2110   423.2
GR2113.5   425.9  2112.7   426.4  2115.4   429.4  2114.8   429.9    2118   432.7
GR2117.7     433  2117.3   433.1  2129.2   465.2  2129.7   472.1    2131   474.2
GR2134.8   491.3  2134.7   533.6  2133.5   534.3  2134.9     537  2134.7   550.9
HD48.959      30   229.4   429.4
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CROSS SECTION #RM149.127

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X149.127      80   147.4   481.7   899.8   899.8   899.8
GR2136.3   138.3    2138   147.4  2136.6   162.4  2133.2   170.3  2130.4   174.6
GR  2123   206.4  2123.3   206.6  2122.7   208.7    2122   209.7    2122   210.7
GR2118.3   219.9  2118.5   220.2  2118.3   221.4  2117.7   222.2  2117.1   225.4
GR2116.8   226.3  2116.8   227.4  2114.7   244.9  2114.4   245.9  2113.9   249.3
GR2112.7   255.4  2110.3   266.8  2110.8   268.8  2109.4   268.9  2110.1   269.8
GR2110.5   270.8  2110.2   287.6  2109.8   289.6  2100.5   364.4  2099.9   365.4
GR2100.6   366.4  2100.7   368.5  2101.3   368.6  2101.2   371.5  2101.9   372.6
GR2102.3   373.7  2102.1   374.7  2102.4   375.7    2104   376.7  2104.4   378.7
GR2103.9   378.8  2104.9   379.8  2106.3     385  2106.4     386  2107.6   390.3
GR2107.8   392.3  2108.1   392.4  2108.2   393.4  2108.2   396.5  2108.7   396.6
GR2108.7   399.7  2108.9   400.7  2108.9   405.8  2109.3   408.8  2109.6   409.9
GR2110.1   415.1  2110.1   420.4  2109.9   421.4  2109.9   423.5  2110.1   423.6
GR2109.9   425.6  2110.1   427.6  2110.1   428.7  2110.7   434.9    2112   436.8
GR2112.1   437.8    2113   438.8  2113.9   440.9  2114.2     441  2114.7   442.1
GR2132.6     458  2132.1   468.3  2134.7     477    2135   477.3  2134.8   478.9
GR2134.8   481.7  2135.1   489.1  2134.8   491.6  2134.9     517  2135.3   535.4
HD49.127      30   225.4   441.0
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CROSS SECTION #RM149.328

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X149.328      79   188.8   531.2  1069.4  1069.4  1069.4
GR2136.1   160.4    2136   183.5  2136.8   188.8  2124.1   243.7  2124.1   245.9
GR2124.1   246.2  2124.4   246.6  2122.6   248.5  2122.9   248.6  2121.1   250.9
GR  2122   251.1  2119.4   252.9    2120   253.4  2117.7   255.2  2117.7   255.5
GR2118.5   256.1  2113.9   259.8    2114   260.1  2115.2   260.5  2112.9   262.2
GR2113.6   262.7  2114.4     263  2110.8   264.2  2111.3   264.8  2112.5   265.1
GR2110.3   266.8  2111.7   267.7  2109.2   268.9  2109.5   269.4  2110.2   269.7
GR2108.9   271.5  2109.2   271.8    2110   272.3  2108.2   273.5  2108.7   274.4
GR2107.5   276.1    2109   276.9  2106.9   278.2  2107.5   278.5  2107.9     279
GR2106.5   280.7  2107.7   281.4  2105.7   285.3  2106.6     286  2105.8     288
GR2105.4   290.1  2105.8   290.6  2105.2   294.6  2105.4   299.3  2106.2   306.3
GR2106.5   310.9  2106.5   318.5  2106.4   320.1  2106.4   329.5    2106   343.7
GR2106.1   353.3  2106.6   359.9  2106.9   371.5  2105.2     405  2107.7   406.3
GR2107.7   413.9    2108   420.6  2108.5   421.5  2109.2   430.2  2109.2   434.8
GR  2107   462.1  2106.4   465.6  2106.8   469.9  2108.4   474.8    2111   478.9
GR2115.7   485.6    2136   519.4    2138   531.2  2133.9   538.4  2131.9   560.1
GR  2132   565.4  2132.6   571.1  2132.4   574.7  2133.4   580.2
HD49.328      30   264.2   478.9
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CROSS SECTION #RM149.560

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X149.560      80   250.2   550.1    1236    1236    1236
GR2135.6   195.9  2135.6   199.7  2136.2   208.6  2133.5   223.5  2136.1   239.2
GR2137.1   250.2    2121   288.5  2119.7   290.7    2120     291  2117.6   293.2
GR2118.1   293.3  2115.4   297.9  2115.6     298  2113.3   300.2  2111.9   302.4
GR2112.4   302.6  2110.8   304.7  2111.2   304.9  2109.9   307.1  2110.4   307.2
GR2108.6   309.3  2109.6   309.4    2108   311.8  2107.3     314  2107.7   314.1
GR2106.5   318.6  2106.8   318.7  2104.1   330.3  2103.8   335.2  2104.5   351.3
GR2104.8   355.7  2104.6   355.8    2105   360.5  2104.7   362.7  2107.3   430.1
GR2107.9   432.2  2107.6   432.5  2107.8   434.6    2107   434.7  2107.3     437
GR2106.2   437.2  2106.6   439.4  2107.8   439.5  2106.1   441.6    2108   441.7
GR2107.3   441.9  2107.8     444    2107   444.2  2107.6   446.4  2106.9   446.5
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GR2107.8   448.7  2107.9   450.9  2107.7   451.1  2107.3   451.2  2107.8   453.3
GR2107.6   453.4  2107.9   455.6  2107.3   455.8  2107.9   457.8  2107.5   458.1
GR2107.9   460.3  2109.1   464.8  2108.7     465  2109.6   467.2  2110.2   469.5
GR2110.8   478.9  2111.7   497.3  2113.7   504.2  2114.2   504.5  2114.9   506.5
GR2116.6     509  2117.7   511.2    2135   536.4  2137.5   550.1  2135.1   559.8
GR2134.7   564.2  2134.3   565.2  2134.4   577.1  2134.8   583.7  2134.6   586.1
HD49.560      30   300.2   504.2
```

CROSS SECTION #RM149.772

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X149.772      80   132.3   512.5  1127.5  1127.5  1127.5
GR2136.3   118.5    2137   126.7  2136.3   127.3  2137.1     129  2136.6   130.6
GR2136.6   131.1  2137.7   132.3  2136.9   132.5  2135.6   158.4  2134.8   160.8
GR2134.4   164.3    2134   164.9  2135.2     165  2134.4   165.8  2134.3   166.2
GR  2135   166.5  2134.3   167.4  2134.8   168.8  2134.2   169.1  2136.1   173.1
GR2132.3   190.5  2129.9   195.6  2121.5   225.7  2122.2   226.4  2120.4   227.8
GR2119.6   231.1    2117   233.7  2117.8   234.2  2116.6   234.9    2116   235.6
GR2115.7   236.9  2114.7   237.5  2113.5   239.6  2111.4   242.1  2110.3   242.9
GR2109.6   244.1  2108.9   244.9    2107   249.3  2103.7     263  2103.3   263.8
GR2103.5   265.2  2103.3   265.8  2102.7   266.4  2103.8   275.1  2104.2   275.7
GR2103.4   276.8  2104.2   278.3  2103.2   278.9  2103.6   279.5  2104.2   286.9
GR  2104   293.2  2104.5   301.2  2104.7     313  2105.1   319.7  2105.1   324.1
GR2104.7   333.3    2108   371.3  2108.4   372.3  2107.8   372.7  2108.3     374
GR2108.1   375.4  2108.5   376.7  2108.7   380.6  2109.6   384.4  2111.7   406.4
GR2113.4   420.7  2114.7   429.8  2115.9   436.4  2118.8   448.2  2137.2   496.1
GR2138.3   506.2  2138.6   512.5  2137.9   532.5  2137.1   533.1  2136.7   534.7
GR2137.3   537.1  2136.2   547.9  2135.8   558.3    2135   567.7  2135.3   570.2
HD49.772      30   235.6   429.8
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CROSS SECTION #RM149.980

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X149.980      80   578.1   955.5  1104.2  1104.2  1104.2
GR2136.6   471.3  2136.8   482.6  2136.4   496.5  2136.7   499.4  2135.9   528.3
GR  2136   543.2  2135.4   556.2    2136   572.8  2136.8   578.1    2135   590.7
GR2131.7   595.4  2127.6   599.1  2123.8   613.8    2124   614.2  2121.8   617.4
GR  2122   618.9  2108.5   637.4  2106.9   638.7  2106.6   640.6  2106.1   642.6
GR2106.6   644.5  2106.2   645.8    2105   646.4    2105   652.8  2105.2   659.4
GR2107.3   664.5    2107   666.5  2107.3   667.1  2107.8     678  2110.3   679.3
GR2110.9   679.9  2108.7   680.7  2107.9   681.2  2109.4   682.4  2109.8   683.1
GR  2108   683.7  2107.7   684.4    2109   685.6  2108.8   686.5  2107.6   687.6
GR2108.4   688.9  2107.1   690.8  2107.7   692.3  2106.3     694  2105.1   699.3
GR2104.4   700.6  2103.2   705.7  2102.9   708.9  2103.1   709.5  2104.3   724.3
GR2105.4   730.7    2107   741.1  2108.2   748.1    2109   762.9    2109     768
GR2111.1   796.3  2111.6     797  2111.5   801.5  2111.9   810.4  2112.4   816.4
GR2112.2   818.1  2113.4   829.2  2114.5   856.3  2115.1   863.3  2116.3   869.7
GR2119.3   879.3  2134.2     910  2135.3   918.4  2136.2   945.5  2136.6   948.9
GR2137.9   955.5  2138.1   959.1  2137.6   969.8  2136.9   970.6  2135.5   994.7
GR2134.6  1037.8  2134.1  1044.6    2134  1053.6  2134.1  1071.7  2134.4  1087.1
HD49.980      30   637.4   863.3
```

CROSS SECTION #RM150.221

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X150.221      80   166.6   531.1  1315.2  1315.2  1315.2
GR2130.1   140.7  2131.9   143.7  2130.7   159.8  2133.1   166.4  2136.8   166.6
```

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GR2111.7   228.7  2113.3   229.2  2110.8   229.8  2108.8   231.3  2110.5   231.8
GR2108.4   232.4  2109.5     233  2106.1   235.7  2108.4   236.2  2105.8   237.7
GR2103.2   242.5  2101.1   251.1  2100.8   254.5  2099.9   255.6  2099.3   262.6
GR2099.2   268.5  2098.7   271.1  2099.2   271.6  2096.3   279.8  2095.2   284.8
GR2094.8   285.3  2094.8   315.6  2095.1   321.9  2095.3     323  2094.8   325.7
GR2093.3   328.8  2092.5   329.3  2091.8     331  2092.3     332  2091.6   334.4
GR2091.9     335  2094.4   348.3  2098.6   364.6  2100.7   375.3  2101.7   384.3
GR2102.9   401.7  2102.6   402.8  2103.3   404.3  2102.9     406  2103.6   408.1
GR2103.2   409.2  2103.8   410.7  2103.6   412.5  2105.8   431.9  2106.2   439.4
GR2105.2   441.2  2106.1   442.8    2105   444.3  2105.3   444.9  2105.5     453
GR2106.1   454.6  2105.6   456.3  2106.6   457.8  2105.9   458.8  2108.5   464.2
GR2107.1   465.8  2108.5   467.7  2108.4   468.1  2107.1   469.2  2109.7   472.5
GR2109.6   478.9  2110.4   481.6  2109.6   482.2    2112   485.9  2112.9   491.1
GR2112.4   492.4  2113.6   492.9  2112.7   494.9  2115.4     496  2114.5   497.8
GR  2129   515.1  2135.5   531.1  2135.4   544.3  2136.1   559.8  2134.5   584.2
HD50.221      30   235.7   469.2
```

CROSS SECTION #RM150.383

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X150.383      80   184.3   484.6   882.5   882.5   882.5
GR2134.1   113.3  2133.7   118.5  2133.5   134.4  2134.3   141.5  2134.5   158.1
GR2133.7   182.9    2134   184.3  2114.3   221.1    2114   221.2  2113.8     224
GR2113.5   224.1  2113.2   225.5  2112.2   234.4  2111.5   237.4  2107.3   246.1
GR2107.3   251.9  2106.9   253.4  2107.5   253.5    2107   257.8  2107.4   262.2
GR2106.8   262.3  2106.5   263.8  2107.2   265.3  2106.4   268.1  2106.6   269.6
GR2107.3   269.7  2106.3   271.1  2107.1   272.5  2106.5   276.9  2106.9     277
GR  2106   278.4  2106.6   279.8  2106.2   281.3  2106.3   282.7  2105.9   284.2
GR2105.4   294.6  2105.8   303.3  2105.5   307.7    2106   316.4  2105.7   319.3
GR  2106   319.4  2106.2   320.8  2105.9   322.2  2105.4   334.1  2105.9   334.2
GR2105.1     337  2105.6   337.1  2104.8   341.4  2105.6   341.5  2104.5   344.2
GR2105.3   344.3  2104.8   345.8  2105.1   347.2  2105.1   367.8  2105.4     368
GR2105.1   379.5  2105.9   384.1  2107.7   389.9  2107.2     390    2108   394.3
GR2108.9   397.2  2111.9   401.5  2113.2   401.6  2112.8     403  2114.7   404.4
GR2118.3   414.9  2119.1   416.5  2119.6   419.2  2136.1   475.8  2137.2   476.3
GR2137.7   484.6  2137.4   485.6  2137.5   488.1  2136.4   492.2  2137.6   493.1
GR2137.2   500.9  2137.1   511.3  2137.4   515.2  2136.5   516.8  2136.8   520.4
HD50.383      30   224.1   401.5
```

CROSS SECTION #RM150.550

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X150.550      80   141.2   459.4   908.9   908.9   908.9
GR2135.1   100.5  2135.1     113  2134.6   117.5  2135.4     118  2134.6   119.7
GR2135.3   129.5  2134.6   135.2  2135.6   141.2  2134.1   163.9  2115.4     210
GR2115.5   213.7  2115.1   214.3  2113.4   214.8  2113.4   220.6  2112.6   221.1
GR2113.9   221.8  2112.8   222.4  2113.5   224.8  2112.6   236.9  2111.2   245.5
GR2110.2   246.1  2111.2   246.6  2110.3   247.4  2109.7   266.1  2110.5   266.7
GR2109.4   267.4    2110   267.9  2109.4   270.4  2110.2   275.4  2109.3   280.8
GR2110.6   281.4  2108.6   282.1  2109.9   282.6  2109.2   283.9  2110.7   284.4
GR2108.6   285.1    2110   285.7  2108.5   288.2  2110.1   288.6  2107.7   289.3
GR2109.4   289.9  2108.6   291.2  2110.1   291.7  2107.7   292.4  2109.4     293
GR  2108   295.4  2109.6   295.9  2107.3   296.7  2109.2   297.2  2108.7   298.3
GR2109.5   298.9  2108.1   299.6  2109.5   300.2    2109   302.7  2109.5   303.4
GR2109.8   313.1  2109.1   319.3    2107   325.2    2106   331.4  2105.9   344.3
GR2105.3   350.3  2103.9   357.5  2102.9   366.8  2102.6   375.3  2103.4   380.8
GR2106.2   389.8  2109.8   397.2  2114.7   401.5  2117.6   407.6  2128.9   438.8
```

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GR2134.9   442.1  2135.2   449.2  2137.7   459.4  2137.4   474.6  2139.4   482.6
GR2138.4   482.8  2142.2   491.6  2142.7   494.5  2142.8   512.5    2139   531.6
HD50.550      30   210.0   401.5
```

CROSS SECTION #RM150.758

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X150.758      80    97.2   460.3  1134.8  1134.8  1134.8
GR2136.4       0  2136.1    28.2    2137    97.2  2131.2   118.9  2130.1   120.5
GR2129.7   122.1  2117.6   190.9  2116.8   207.5  2116.3   210.5  2115.4   212.3
GR2115.8   212.9  2115.1   215.4  2115.4   216.4  2115.2     218  2112.6     249
GR2112.8   249.8    2112   250.5  2112.3   252.9  2111.7   253.6  2111.9     256
GR2111.4   256.8  2111.4   258.4  2110.5   267.8  2109.2   279.1  2108.6     280
GR2108.3   281.5  2107.5   282.3  2106.7   284.7  2105.9   285.5    2102   296.6
GR2102.4   297.5  2101.3     300  2102.5   307.8  2103.3   308.6  2103.6   309.4
GR2102.5   310.2  2103.8   311.7  2103.4   313.4  2102.7   314.2  2103.4   315.7
GR2102.9     318  2103.3   319.6  2102.4   325.4    2103   326.9    2103   327.8
GR2102.6   328.5  2103.3   330.2  2103.4     331  2102.6   331.7  2103.6   334.1
GR  2103   334.8  2103.8   336.4  2103.9   339.6  2102.8   341.2  2103.3     342
GR2103.1   342.7  2101.9   344.4  2102.5     345  2101.6   347.6  2102.2   348.2
GR2101.8   350.6  2102.4   354.9  2103.8   359.5  2104.9   365.2  2105.5   365.9
GR2105.8   367.5  2108.8     373  2109.5   373.7  2109.5   374.5  2111.1   375.3
GR  2112   376.1  2113.7   381.1  2115.6   384.2  2117.7   389.8  2117.8   392.2
GR2136.8   460.3  2135.5   476.5  2134.1   485.4  2134.6   485.9  2134.6   557.3
HD50.758      30   207.5   389.8
```

CROSS SECTION #RM150.960

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X150.960      80  1197.5  1576.6  1103.4  1103.4  1103.4
GR2135.1  1052.3  2134.9  1057.2  2135.9  1099.3    2136  1112.2  2135.4  1118.1
GR2136.6  1149.5  2136.8  1178.5  2138.1  1197.5  2135.7    1227    2132  1255.3
GR2116.1  1269.6  2116.1  1270.4  2117.2  1271.6  2115.7  1273.5  2115.8  1274.3
GR2116.7  1275.8  2115.2  1276.6  2115.3  1277.4  2115.9  1279.1  2114.8  1279.9
GR2115.3  1282.2  2114.4    1283  2114.7  1285.3  2114.1  1286.3  2114.2  1288.4
GR2111.7  1300.6    2111  1310.3    2113  1325.8  2112.6  1326.9    2113  1328.3
GR2113.2  1334.7  2114.7  1344.2  2114.7  1352.9  2113.9  1372.2  2113.9  1383.1
GR2113.6  1384.2  2113.8  1386.5  2113.5  1387.3  2113.7  1389.6  2113.1  1390.6
GR2113.5  1393.5  2112.8  1419.8  2111.5  1439.8  2109.1  1448.5  2108.9    1450
GR2108.8  1453.3  2109.4  1458.3  2109.3    1463  2109.5  1467.6    2110  1472.5
GR2109.7  1473.8  2110.5  1474.8  2110.3  1477.1  2111.3  1478.7    2111  1479.6
GR2110.4  1480.2  2111.1    1482  2109.8  1483.5  2109.7  1484.3  2110.6  1485.2
GR  2110  1486.6  2111.5  1496.3  2112.3  1500.3  2112.9  1502.7  2114.8    1506
GR2115.6  1506.7  2117.9  1510.6    2135  1560.1    2136  1566.3  2136.8  1576.6
GR2136.2    1582  2136.4  1582.6  2136.1  1599.6  2136.7  1623.6  2136.7  1645.9
GR2137.1  1675.7  2136.7  1692.5  2137.2  1695.2  2136.7  1702.8  2137.4  1706.8
HD50.960      30  1269.6  1510.6
```

CROSS SECTION #RM151.154

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X151.154      80  1816.1  2239.7   971.9   971.9   971.9
GR2134.4  1737.3  2135.3  1769.9  2134.1  1773.4  2137.9  1816.1  2136.6  1822.7
GR  2135  1827.4  2134.6  1830.5  2135.1  1830.9  2134.4  1832.5  2133.4    1834
GR2133.7  1834.2  2132.7  1839.3  2129.8  1845.5  2131.6  1845.7  2129.3  1846.9
GR  2114  1911.4  2114.2  1911.6  2111.3    1918  2111.6  1918.2  2109.3  1924.6
GR2107.9  1934.4  2106.7    1941  2105.5  1944.1  2106.1  1944.3  2105.1  1947.4
```

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GR2105.6  1947.6  2104.2    1954  2104.5  1954.2  2103.5  1957.3  2103.9  1957.5
GR  2102  1960.6    2103  1960.8  2101.2  1963.9  2102.1  1964.1  2100.4  1967.2
GR  2101  1967.4  2098.3    1977  2097.7  1983.6  2097.8  1990.2  2096.8  1993.3
GR2097.3  1993.5  2094.7  1999.9  2095.2  2000.1  2092.5  2006.5  2092.9  2006.7
GR2091.9  2009.8  2092.3    2010  2091.8  2013.1  2092.5  2022.9  2096.5  2036.1
GR  2101    2046  2103.4  2052.6  2106.2    2059  2106.7  2059.2    2110  2072.2
GR2112.4  2072.4  2111.9  2075.4  2114.4  2075.7  2115.8  2078.7  2116.5    2082
GR2117.9  2095.2  2136.1    2164  2136.2  2167.9  2135.3  2179.2  2137.9  2185.4
GR2138.4  2190.3    2138  2192.4  2136.1    2194  2136.1  2199.2  2139.3  2205.3
GR2137.4  2207.4  2140.8  2225.1  2139.8  2228.6  2139.7  2229.8  2141.1  2239.7
GR2140.9    2243  2141.1    2256  2142.4  2295.7  2142.6  2318.6  2142.8  2323.9
HD51.154      30  1911.4  2075.7
```

CROSS SECTION #RM151.384

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X151.384      80      61   481.2  1122.6  1122.6  1122.6
GR2137.8       0    2139      61  2128.3     101  2118.7   135.6    2119   135.8
GR2114.7   142.6  2114.3   144.9    2114   145.1  2114.1   147.3  2112.9   149.6
GR2113.3   149.7  2113.2   151.9  2112.8   154.2  2111.9   156.4  2112.5   156.6
GR2112.6   158.8  2112.2   161.1  2111.9   161.4    2110   168.2  2109.8   170.4
GR2110.1   175.1  2110.3   175.2  2110.4   179.7  2109.6   184.4  2109.8   184.5
GR2109.1   186.7  2107.8   191.2  2107.4     196  2109.2   205.2  2110.4   214.6
GR2110.6   219.3  2110.9   221.5  2110.6   221.6    2111   223.8  2111.1   228.4
GR2110.9   237.6  2111.3   237.8  2111.6     240  2110.9   240.2  2111.6   242.3
GR2111.2   242.6    2112   244.6  2111.2   244.7  2111.6   244.9  2111.6   247.1
GR2112.5   249.4  2112.8   251.7  2112.1   251.9  2112.3   253.9  2112.8   254.1
GR  2113   256.4  2112.2   258.6  2112.9   258.7  2113.3   263.2  2114.2   265.6
GR2115.1   270.1  2115.4   281.7  2115.1   281.9  2115.4   288.8  2115.2   291.2
GR2115.6   300.3  2115.9   300.5  2116.4   321.4  2115.5   335.1    2115   337.5
GR2115.5   339.8  2115.2   339.9  2115.8   342.1  2115.5   346.6  2115.7   346.8
GR2115.8   353.7  2116.8   365.4  2117.3   376.9  2117.3   383.9  2117.5   386.2
GR2129.7   413.7  2129.9   418.1  2134.8   481.2  2134.4   491.8  2134.4   583.7
HD51.384      30   142.6   386.2
```

CROSS SECTION #RM151.693

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X151.693      80   141.1   511.7  1508.1  1508.1  1508.1
GR2137.5   118.2  2137.2   122.4  2137.6   141.1  2136.9     164  2136.3   170.6
GR2129.5   193.4  2107.1   237.7  2105.7   240.9  2104.1   246.1  2103.4   249.5
GR2103.4   251.3  2103.7   252.3  2102.9   252.4  2103.5   255.5  2102.8   255.6
GR2103.6   258.6  2103.1   259.7    2104   262.7  2103.3   262.8  2104.3   265.8
GR2103.5   265.9  2104.6   268.8  2103.7     269  2105.4   272.9  2104.3     273
GR  2106     276  2104.7   276.1  2106.5   279.2  2105.1   279.5  2106.4   281.5
GR2106.8   285.6  2106.4   289.6  2105.5     297  2105.1     298  2104.7   301.1
GR2105.1   307.1  2105.3   313.6  2105.1   321.8  2106.1   323.8    2105   323.9
GR2106.5   327.1  2107.2   338.5  2106.2   338.6  2106.7   339.5    2107   341.6
GR2106.2   341.8  2106.5   343.7    2106   347.7  2105.7   348.7  2106.2   348.8
GR2106.1     354  2106.9   358.1    2108   372.7  2108.1     385  2107.7   387.2
GR2107.9   389.2  2107.3   389.6  2107.5   393.4    2107   393.6  2107.1   396.6
GR2105.5   403.8    2103     411  2102.8   412.2    2102   414.1  2101.5   417.2
GR2101.8   420.4  2102.7   424.7  2105.2   432.9  2108.9     441  2111.3   445.6
GR2117.8   453.7  2117.2   454.6    2118   454.8  2118.4   455.8  2118.6   457.8
GR  2121     464  2138.1   511.7    2138   535.5  2136.5   555.3  2136.8   557.6
HD51.693      30   237.7   441.0
```

CROSS SECTION #RM151.902

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X151.902      80   146.3   497.8  1022.2  1022.2  1022.2
GR2137.9    76.2  2137.5    86.2    2138   141.6  2138.6   146.3  2113.6   217.1
GR2114.3   219.6  2113.6   219.9  2112.7   227.2  2111.8   247.6  2112.7     248
GR2111.4   248.8  2112.3   249.2  2111.6   250.5  2112.5   250.9  2112.1   252.1
GR2111.3   253.2  2112.3   253.8  2111.8     255  2112.3   255.3  2111.6     258
GR2112.1   258.2  2111.3   260.8  2111.9   261.2  2111.8   274.5  2110.2   275.3
GR2111.9   275.7  2111.8   278.5  2110.1   279.9  2111.8     280  2111.3   281.4
GR2111.6   281.7  2111.6   283.1    2110   284.2  2111.5   284.7  2110.4   285.8
GR  2110   288.9  2111.3     289  2109.9   290.5  2109.9   291.7  2110.9   292.2
GR2109.9   293.3  2109.3     301  2109.7   303.4  2109.5   309.5  2109.7     315
GR2110.4     327  2112.2   327.4  2110.3   328.3  2111.3   328.7  2110.4   329.9
GR2111.4   330.2  2110.7   331.5  2111.3   333.2    2112   334.3  2111.2   338.9
GR2110.5     340  2111.7   340.3  2111.3   341.6  2112.4     342  2112.9   343.3
GR2110.2     345  2109.4   346.5  2109.1   349.3  2109.5   359.2  2109.3   359.6
GR2109.7   373.7  2108.8   400.7  2110.6   409.4  2111.4   418.3  2114.3   426.8
GR  2115   427.1  2115.3   428.3  2116.3   428.7  2116.6   431.2  2118.2   435.5
GR  2119   438.8  2138.1   497.8    2138   504.4  2137.3   508.4  2136.9   557.6
HD51.902      30   217.1   425.4
```

CROSS SECTION #RM152.139

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X152.139      80     239   565.8  1213.7  1213.7  1213.7
GR2139.2   189.8  2139.5   204.2  2139.8   207.8  2139.4   215.7  2140.1   227.8
GR2141.7     239  2140.8     240  2140.4   243.7  2137.2   255.8  2134.2   261.7
GR2134.3   262.2  2132.1   265.2  2128.6   268.1  2113.7   300.5  2112.1   307.3
GR2111.7   307.6  2111.7   309.6  2111.5   309.7    2110   316.8  2109.6   316.9
GR2109.9   318.9  2109.4   319.1    2109   321.3  2108.6   321.5  2108.9   323.4
GR2108.3   323.6  2108.2   325.8  2107.6     326    2108   328.2  2107.4   328.4
GR2106.2   337.4  2105.6   337.5  2105.9   337.6  2104.9   342.2  2104.3   342.4
GR2101.7   351.4  2101.3   351.6  2100.8   353.7  2100.2     354  2099.8   356.1
GR2097.6   360.7  2095.1   367.8  2093.4   374.6  2093.8   374.7  2093.2   383.9
GR2093.5   384.1  2094.1   393.4  2095.1   402.6  2096.7   411.8  2102.3   441.7
GR2103.1   444.3  2104.3   446.5  2104.1   446.7  2105.7   451.2    2112   462.8
GR2111.7     463  2111.2   463.1    2114   467.5  2113.2   467.6  2115.8   469.7
GR2114.4   469.9  2116.4     472  2115.2   472.3  2117.7   474.4  2116.4   474.7
GR2118.2   476.6  2117.7   476.8    2119     479  2118.5   479.2  2119.5   481.3
GR2119.4   481.5  2131.4   504.1  2134.1   516.7  2140.1   534.4  2139.9   534.6
GR2141.6   545.7  2142.9   565.8  2142.1   588.5  2143.3     596  2143.6   596.7
HD52.139      30   300.5   469.7
```

CROSS SECTION #RM152.317

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X152.317      80   645.7  1002.7   940.8   940.8   940.8
GR2135.2     601  2136.6   616.6  2137.3   618.9  2137.9   638.5  2139.2   645.7
GR2135.7   692.6  2117.8   737.9    2115   743.8    2114   744.9  2113.4   747.2
GR2112.6     748  2112.4   750.4  2111.6   751.2  2111.3   753.7  2110.8     754
GR2110.2   755.2  2110.3   756.9  2109.5   757.8  2109.3   758.4  2109.7   760.1
GR2109.2   760.5  2108.8   761.5  2108.9     762    2108   770.4  2107.5   771.3
GR2106.5   787.5  2106.6   794.5    2107   794.9  2106.6   796.8  2106.7   800.6
GR2107.2   801.4  2106.8   803.7  2107.5     805  2106.8   807.1  2107.7   808.4
GR2106.9   810.1  2107.1   810.7  2107.7   811.5  2107.1   813.4  2107.3   814.5
GR  2108   837.7  2107.6   843.6  2108.2   854.4  2108.3     863  2108.3   870.6
```

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GR2107.7   886.2  2107.2   910.9  2107.3   917.1  2107.8   917.9  2107.6   919.6
GR2108.3   920.8  2108.8   921.1  2108.7     923  2110.1   924.4  2110.1   926.1
GR2110.9   927.2  2111.6   927.6  2111.6   929.5  2113.3     931  2128.3   966.8
GR2129.2     970  2130.1   970.8  2129.7   971.3  2130.3   971.5  2137.9   996.6
GR2138.1  1002.7  2137.9  1006.9  2138.1  1010.5  2137.5  1012.9  2138.6  1015.8
GR2139.6  1019.6    2141  1020.9  2141.8    1023  2142.6  1029.3  2142.4  1047.7
GR2138.2  1061.3  2136.9  1061.8  2137.9    1062  2133.7  1067.7    2133  1071.5
HD52.317      30   747.2   931.0
```

CROSS SECTION #RM152.496

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X152.496      80     658  1034.2   950.8   950.8   950.8
GR2138.2   561.9  2137.7   569.1  2137.9   585.8  2138.8   595.1  2138.4   595.5
GR  2139   597.2  2140.3   637.5  2139.9   655.6  2140.4     658  2140.1   658.2
GR2137.9   683.7  2136.7   686.5  2133.6   695.7  2133.6   696.6  2130.2   707.8
GR2117.5   738.4  2117.8   739.2  2116.7   741.5  2116.8     743    2115   745.3
GR2115.5   745.8  2115.5   746.6  2114.2   748.5  2114.8     750  2113.6   751.9
GR2114.1   753.1  2113.1   754.8  2113.2   756.1  2111.5     762  2111.5     763
GR  2111   764.7  2109.9   775.5    2110   775.9  2109.7   799.2  2109.4     808
GR2109.1   809.3  2109.1   811.6  2108.8   812.7  2108.9   818.2  2108.7   819.6
GR2107.8   835.4  2107.7   841.8  2107.1   845.6  2106.1   848.7  2105.6   849.4
GR2105.5   851.7  2105.1   851.9  2104.7   852.5    2105   854.2  2104.5   855.9
GR2104.3   861.8  2103.6   872.6  2103.1   874.3  2103.9   874.7  2103.5   875.1
GR2102.5   878.9  2100.8   881.7  2100.9   882.7  2100.4   890.9  2100.5   898.5
GR2101.9   905.7  2101.9   911.4  2105.2   921.8  2106.7   924.3  2106.8   925.4
GR2108.7   928.1  2142.9  1026.7  2143.3  1034.2  2143.3  1046.5  2139.3  1062.7
GR  2138  1066.3  2137.8  1069.5  2136.3  1071.8  2136.5  1075.8  2136.9  1076.9
GR2138.4  1086.4  2136.4  1087.2  2137.4  1090.4  2137.5  1093.1  2136.1    1095
HD52.496      30   751.9   928.1
```

CROSS SECTION #RM152.661

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X152.661      80   385.7   748.3   871.8   871.8   871.8
GR2135.5   257.9  2136.6   262.8  2139.7     303  2140.1   385.7  2138.8   399.5
GR2118.8     461  2115.8   461.9  2117.7   463.2  2115.9   464.1    2115   465.2
GR2115.2   466.1  2115.5   466.3  2115.3   467.3  2114.2   468.3  2112.6   471.4
GR2111.9   473.5  2111.3   474.4  2109.8   478.6    2109   479.5  2109.5   479.7
GR  2106   484.7  2104.6   487.8  2103.8   491.1  2103.1   496.3  2102.5   506.8
GR2102.5   513.9    2103   523.3  2103.5   525.3  2103.1   526.4  2103.9   528.4
GR2102.9   529.5  2104.1   531.6    2103   532.7  2103.8   534.7  2103.6   538.9
GR2103.9   539.8  2103.5   541.8  2104.3   542.1  2104.1     545    2105   549.2
GR2107.5   557.5  2108.4   563.7  2108.6   571.1  2108.4     572  2108.9   573.1
GR2108.4   575.1  2108.7   584.5  2108.3   586.5  2108.8   587.6  2108.2   589.6
GR2108.4   591.7  2107.7   593.7  2108.7   593.9  2108.2   594.8  2107.5   596.8
GR2108.1   597.9  2107.2     601  2108.2   601.1  2107.9   602.2  2107.7   604.2
GR2108.4   605.3  2108.4   607.3  2108.8   608.4  2108.8   610.4  2109.2   616.7
GR2112.6   644.6  2113.4   659.1  2113.8   661.1  2135.5   706.8  2137.4   714.6
GR2138.2   719.5  2137.9   722.3  2143.9   748.3  2143.6   770.6  2137.1   783.6
GR2137.3   784.9  2136.4   789.8  2136.4   791.4  2135.7   792.1  2136.1   806.6
HD52.661      30   468.3   659.1
```

CROSS SECTION #RM152.819

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X152.819      80   343.3   646.7   835.4   835.4   835.4
```

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GR2136.4   257.7  2136.2   260.1  2138.6   276.3  2139.5   285.2  2139.1   298.9
GR2136.3   315.8  2137.2   320.7  2136.8   329.7  2137.9   331.8  2138.3   334.3
GR2137.1   337.4  2137.3     340  2138.2   343.3  2133.4   360.2  2131.9   361.1
GR  2132     367  2117.2   392.9    2117   395.5  2116.1   400.2  2115.8   402.8
GR2113.5   411.9  2113.7   414.5  2112.9   414.8  2113.7   415.9  2113.1   416.2
GR2113.2   418.9  2111.5   423.2  2109.7   424.9  2111.3   425.3  2108.5   426.3
GR2109.5   426.5  2105.5     431  2103.6   435.2  2102.1   436.6  2102.8   436.8
GR2100.1   441.1  2099.8   442.9  2099.1   443.9  2098.5   454.2  2099.1   454.5
GR2098.1   455.4  2099.1   455.9  2100.2   464.6  2100.4   470.5    2101   479.2
GR2103.1   497.2  2104.5   502.9  2105.3   505.5  2104.5   505.7  2105.5     510
GR2106.4   511.6  2105.4   511.8  2107.3   512.8  2106.4     513    2107   514.6
GR2106.2   514.9  2107.9   515.8  2106.2   516.1  2107.4   522.1  2108.2   523.1
GR  2108   523.6  2109.9   529.2  2110.2   529.4  2111.2   535.1    2112     541
GR2113.2   557.1  2118.1   589.4  2128.1   624.7  2133.8   636.2  2135.5   646.7
GR  2135   651.2  2135.3   651.7  2134.7   656.8  2135.1   657.8  2134.4   678.9
GR2134.8   679.2  2135.1   695.4    2135   704.8  2135.8   745.2  2135.7     752
HD52.819      30   400.2   589.4
```

CROSS SECTION #RM153.002

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.002      80  1966.1  2534.4   969.3   969.3   969.3
GR2133.1    1886    2134    1897  2133.9  1907.2  2133.1  1922.6  2132.7  1923.5
GR2135.4  1930.8  2135.7  1943.2  2135.9  1945.4  2139.7  1966.1  2136.9  1988.3
GR2136.7  2001.4  2137.1  2002.2  2137.2    2014  2130.2  2046.2  2115.4  2092.8
GR2114.9  2096.3  2113.8  2099.2  2112.6    2100  2112.2  2102.5  2106.5    2116
GR2105.3  2122.4  2101.8  2128.9  2101.3    2132  2100.7  2133.5  2101.7    2145
GR2101.5    2146  2102.4  2152.6  2102.7    2153  2105.5  2161.8  2105.3  2162.6
GR2106.7  2176.2  2106.6  2176.8  2107.2  2178.4  2107.2  2179.5  2108.4  2185.6
GR2108.3  2185.8  2110.2  2196.1    2112  2208.2  2113.3  2222.2  2113.1  2222.6
GR2114.4    2232  2114.1  2235.1  2114.1  2245.4  2114.8  2261.6  2114.7  2264.3
GR2115.1  2271.9  2115.8  2272.7    2115  2274.5    2116    2276  2115.3  2277.8
GR2116.3    2279  2115.7  2281.1  2116.5  2282.3  2116.2  2284.4  2116.9  2285.6
GR2116.8  2287.5  2131.6  2337.1  2133.6  2348.5  2134.7  2364.1    2134  2380.1
GR2135.4  2397.1  2135.9  2413.8  2135.7  2438.2  2135.7  2450.9  2136.3  2469.4
GR2136.7    2472  2136.7  2506.6  2138.2  2534.4  2138.3  2545.2    2138  2556.4
GR2137.1  2559.6    2137  2565.3  2137.3  2574.3  2136.9    2586  2137.1  2586.2
GR2136.4  2587.9  2137.4    2599  2137.6  2617.7  2137.6  2633.7  2136.1    2670
HD53.002      30  2092.8  2287.5
```

CROSS SECTION #RM153.188

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.188      79   249.4   638.4  1029.6  1029.6  1029.6
GR2140.3     138  2139.9   168.7    2140   171.2  2140.6   174.2  2140.1   178.4
GR2141.9   179.2  2135.5     238  2135.8   249.4  2134.9   257.5  2135.5   266.2
GR2114.6     297  2114.6   299.4  2113.6   306.6  2113.3   320.3  2111.9   327.1
GR2111.6   329.4    2111     341  2111.5   346.1  2112.3   350.5  2112.5   352.7
GR2112.6   357.3  2112.8   357.6  2112.7   361.8    2114   378.4  2113.5   385.3
GR2112.9   396.7  2113.3   403.5  2113.6   413.2  2114.2   420.2    2116   429.3
GR2115.6   429.5  2116.2   431.5  2114.4   440.8  2114.4   443.4    2114   452.4
GR2114.2   452.7  2114.7   464.1  2114.9     471  2114.6   471.3  2114.9   473.4
GR2114.6   473.7  2114.1   489.8  2114.2   506.2  2115.9   517.4  2115.7   517.7
GR2116.3   529.2  2116.1   529.3  2118.5   536.1  2119.2   540.8  2119.3     543
GR2118.9     550  2119.9   557.2  2119.2   559.4  2120.1   559.6  2119.4   561.6
GR  2120   561.9  2119.4   563.8    2120   564.1  2120.4   568.8  2120.4     571
GR2121.6   577.8  2120.8   578.1  2129.2   619.8  2129.9   620.6  2130.2   621.7
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GR2134.7   627.8  2138.7   638.4  2138.6   641.5  2138.2   642.1  2140.8   687.9
GR2140.4   692.8  2140.9   696.4  2141.1   705.5  2140.4     711  2140.9   714.5
GR2140.2   727.4  2140.5   736.5  2139.7   742.8  2140.2   743.1
HD53.188      30   297.0   506.2
```

CROSS SECTION #RM153.362 ROSE LAKE GAGING STATION

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.362      55   130.8   601.1   959.9   959.9   959.9
GR2141.3   114.6  2141.7   130.8  2141.2     137  2139.7   161.6  2136.7   204.7
GR2131.9   226.9  2111.8   269.2  2111.9   271.2  2103.5     294  2100.8   295.4
GR2098.7   303.3  2095.1   315.1  2094.4   324.8  2092.9   338.2  2086.3   357.6
GR2079.1   386.4  2077.8   389.8  2073.7   412.2  2072.5   423.9  2072.6   437.2
GR  2074   449.6  2076.2   460.6  2075.7   463.5  2075.1     466  2075.1   468.6
GR  2076   470.6    2076   473.2  2077.2   475.1  2078.9   482.4  2080.5   484.4
GR2080.7   486.9  2081.3   489.3  2082.7   491.4  2084.9     496  2086.7   498.1
GR2092.4     510  2094.9   515.2  2096.6   517.2  2098.3   519.7  2105.4   525.7
GR2105.1   526.9  2107.3   528.2  2111.5   534.9  2111.1   536.3  2112.7   537.6
GR2118.6     550  2127.8   565.8  2136.9   578.4  2142.4   587.4  2146.9   601.1
GR2146.8   607.2  2144.3   632.7  2143.8   659.9  2144.1   675.3  2143.7   678.1
HD53.362      30   338.2   510.0
```

CROSS SECTION #RM153.560

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.560      80   401.9   766.9  1095.9  1095.9  1095.9
GR  2143   317.5  2145.4   346.2  2146.3   401.9  2139.7   436.5  2135.5   447.3
GR2133.6   450.6    2131   452.8  2128.5   458.8  2119.1   476.4  2117.8   480.6
GR2110.9   493.1  2110.7   495.1  2110.1   495.4  2109.2   502.6  2108.5   521.1
GR  2109   521.8  2109.3   536.3  2109.3   544.1  2108.8   546.7  2109.2   547.2
GR2108.7   565.7  2108.1   579.1  2107.9   599.8  2107.7   600.9  2108.4   601.2
GR2107.6   604.9  2108.3   605.3  2107.8   607.1  2107.9   610.4  2107.6   633.3
GR2107.2   635.1  2107.8   635.5  2106.9   639.3  2107.6   639.7  2107.1   641.5
GR2107.4   662.2  2106.7   666.2  2105.1   669.7  2103.9   673.9  2103.9     677
GR  2109   688.2  2110.7   690.2  2109.5   690.4  2111.8   693.3  2110.6   693.7
GR2113.6   697.2  2112.5   697.9  2114.2   699.6  2115.3   700.3  2113.7     701
GR2114.5   701.6  2128.6   727.5  2127.3   730.7  2129.4   732.7  2128.6   733.8
GR2129.7   734.5  2130.9   734.9  2132.6   738.2  2132.8   742.8  2136.4   752.3
GR2138.4   761.2  2138.9   761.4  2139.6   762.9  2138.9   763.6  2138.4   766.4
GR2139.7   766.9  2139.7   783.6  2138.6     795  2138.7   801.4  2138.1   804.1
GR2138.6   812.1  2138.6   828.4  2140.5   840.7  2139.6   844.2  2140.8   844.7
GR  2139   847.7  2140.6   848.4  2140.6   868.9  2139.2   873.5  2138.2   874.2
HD53.560      30   495.4   688.2
```

CROSS SECTION #RM153.758

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.758      80   322.1   683.8  1096.1  1096.1  1096.1
GR2137.5   217.5  2138.6   238.1  2141.1     248  2141.1   253.9  2139.7   271.2
GR2139.6   278.5  2140.7   300.8    2140   302.1  2140.4   307.4  2140.9   322.1
GR2136.8   367.7  2117.3     408  2117.5   408.7  2115.6   414.2  2115.8   414.8
GR2114.5   418.5  2114.3   424.5    2114     425  2111.8   426.4  2108.9     441
GR2108.4   442.7  2108.5   448.4  2108.1   448.9  2108.2   452.7  2107.4   453.2
GR2108.3   453.7  2107.4   454.4  2107.3   461.7  2107.9   476.2  2107.8   481.9
GR  2107   482.3  2106.4   488.5  2107.4     489  2106.3   489.7  2106.5   497.1
GR2107.3   512.9  2108.4   519.5  2108.5   521.9  2109.1   523.2  2108.4   523.7
GR2109.7   524.6  2108.4     525  2108.8   526.2  2108.3   534.2  2109.8   534.7
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GR2108.3   535.4  2108.5   539.6  2109.2   540.9  2108.4   541.6  2109.6   542.1
GR2108.5   542.7  2109.1   543.9  2108.8   551.9  2109.3   552.4  2108.9   553.1
GR2109.2   558.6  2109.9   563.4  2109.7   568.9  2109.1   569.6    2110   570.1
GR2109.2   570.7  2109.2   579.3  2108.3   579.7  2109.5   580.4  2108.6   581.1
GR2108.9   582.4  2108.9   592.8  2108.3   599.9  2108.4   605.5    2109   606.1
GR  2110   611.4  2111.1   615.8  2130.1   654.4  2132.8   661.2  2134.4   667.9
GR2136.4   683.4  2136.8   683.8  2137.2   744.3  2136.4   755.8  2136.6   778.3
HD53.758      30   426.4   615.8

   CROSS SECTION #RM153.948
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X153.948      80   312.9   673.3    1049    1049    1049
GR2139.8   232.8  2139.7   240.2  2138.7   248.1  2140.6   268.9  2141.5   304.8
GR2141.9   312.9  2141.3     321  2135.4   344.5  2119.3   376.7  2117.9   381.6
GR2117.4   382.3  2114.1   388.5  2112.8   392.6  2113.3   393.2  2112.6   393.8
GR2112.9   394.3  2111.1   403.1  2111.5   403.5  2110.7   404.2  2111.3   404.7
GR2110.8   408.9  2109.7   432.7    2110   434.1  2110.5   441.9    2110   445.7
GR2110.4   446.1  2109.8   446.8  2110.2   447.3  2109.3   457.2  2109.7   457.7
GR2109.5   459.1  2110.1   468.1  2109.8   473.6    2110   475.5    2110   488.2
GR2109.5   488.9    2110   489.6  2109.6   491.9    2110   492.4  2108.4   501.6
GR2108.9   502.1  2108.1   502.8  2108.7   503.5  2108.3     506  2108.9   506.5
GR2108.4   507.2  2108.8   507.6  2108.8     509  2109.2   509.5  2110.2   516.9
GR2110.4   522.4  2110.6   535.6  2110.3   541.4  2110.5   553.4  2110.1   555.8
GR2110.6   556.5    2110   557.1  2110.4   557.6  2110.2   558.8  2111.1   572.4
GR2111.1   578.4  2111.2     581  2110.9   581.4  2111.4   591.2  2111.7   591.8
GR2111.6   592.5  2114.3   600.4  2127.8   609.1  2129.5   634.4  2130.4   638.1
GR2132.1   641.6  2132.4   643.6  2132.8   643.9    2135   647.9  2137.1   654.5
GR2137.8   659.2  2138.7   673.3  2138.3   673.5  2137.2   688.8  2135.7   732.2
HD53.948      30   392.6   600.4

   CROSS SECTION #RM154.129
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X154.129      80   292.3   660.9  1002.3  1002.3  1002.3
GR2138.7   205.3  2140.1   221.8  2140.1   232.3  2141.9   258.3    2141   265.1
GR2140.9   269.5  2141.4   276.9  2141.2   292.3  2135.8   311.4  2134.6   318.6
GR2118.8   370.4  2116.8   376.4  2116.1   379.3  2115.9   382.3  2115.2   385.2
GR2115.3   386.7    2115   389.7    2113   397.1  2111.9   408.9  2112.7   430.6
GR2112.3   439.6  2111.6   442.5  2111.6   445.4  2112.4   448.3  2111.6   448.5
GR2112.3   451.1  2111.6   451.4  2111.7   452.8  2112.2   454.2  2111.5   454.4
GR2112.4   455.4  2111.6   455.6  2112.1   457.1  2111.5   457.3  2112.4   458.5
GR2111.9   460.2  2112.2   461.4  2111.5   461.6  2112.4   462.9  2111.6   463.1
GR  2112   464.3  2111.3   464.5  2112.3   465.9  2111.7   467.4  2112.1   473.1
GR2111.7   473.3  2112.2     476  2111.7   476.2  2112.1     479  2111.5   479.3
GR  2112   480.5  2111.5   480.7  2111.9   481.9    2112   487.7  2111.8   487.9
GR2112.1   489.3  2112.1   509.9  2111.8   514.4  2111.5   515.8  2110.1   537.7
GR2110.6     538  2110.1   539.2  2110.2   542.3  2109.8   553.8  2109.4   571.4
GR2109.4   576.2  2110.1   583.1  2110.9   587.9  2112.4   592.2  2115.1   601.0
GR2128.6   637.1  2128.2   638.4  2133.1   643.4  2139.2   660.9  2138.7   669.8
GR2138.8   677.8  2138.4   696.7  2136.1   736.8  2134.6   791.5  2134.8   792.2
HD54.129      30   382.3   601.0

   CROSS SECTION #RM154.318
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X154.318      80   325.1   697.2  1041.2  1041.2  1041.2
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GR2139.4   241.9  2139.2   244.2    2140   249.1  2139.9   249.7  2140.2     250
GR2139.6   250.2  2140.4   251.7  2140.2   253.3  2139.8   253.7  2140.6   254.5
GR  2141     264  2140.7   271.2  2140.3   274.5  2140.1   285.2  2139.6   287.8
GR2139.9   289.5  2139.6   293.6  2139.8   302.1    2140   319.8  2140.4   325.1
GR2140.1   329.1  2135.9   338.5    2119   386.5  2118.7   387.9  2118.2   388.1
GR2117.3   392.1  2116.9   392.5  2116.7     394  2114.8   399.8  2114.8   405.8
GR2114.4   406.8    2115   407.3    2115   408.4  2114.8   408.9  2114.6   409.8
GR2114.8   410.3  2114.7   411.4  2113.2   417.5    2113   418.9  2112.8     425
GR2113.4     431  2113.3     442  2113.6   442.5  2113.4   443.6  2113.9   451.1
GR2114.4   461.4  2114.3   462.8  2114.5   463.2  2114.2   464.2  2114.5   464.4
GR2114.4   470.2  2114.4   476.1  2113.9   481.7  2113.8   482.1  2113.9   484.7
GR2113.4   499.4  2113.6     509  2112.4   518.7  2112.4   524.4  2112.5   524.8
GR2112.5   539.5    2112   546.5  2112.4   561.4  2111.8     579  2111.8     582
GR  2111   583.4  2111.4   584.5  2111.3     585  2111.6   587.6  2111.5   590.6
GR2111.8   591.1  2111.7     592  2112.2   598.5  2112.1   608.3  2112.3   609.8
GR2112.2     610  2115.3   626.1  2129.2   677.2  2139.6   697.2  2138.8   729.7
HD54.318      30   399.8   626.1
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CROSS SECTION #RM154.518

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X154.518      80     178   590.6  1100.5  1100.5  1100.5
GR  2139   135.2  2139.3   154.8  2138.4   159.5  2138.6   168.4  2138.8   169.5
GR2139.5     170  2141.2     178  2139.4   209.8  2138.8   212.3  2131.4   228.6
GR2129.9   229.6  2120.1   268.9  2119.8   269.3  2116.7   277.1  2114.3   286.9
GR2114.8   287.8  2114.3   288.7  2113.7   299.4  2113.7   314.9  2114.1   331.5
GR2114.1   352.8  2113.9   357.1  2113.4   357.6    2113   362.6  2112.6   374.2
GR2113.1   385.6  2113.1   390.6  2113.3   395.6  2114.1     404  2113.7   417.4
GR2113.1   419.9  2113.5   420.6  2112.8   422.9  2113.4   423.7  2112.5     424
GR  2113   424.6  2112.6   430.1    2113   430.8  2112.7   431.3  2112.6   439.4
GR2112.8   443.8  2113.2   444.2  2112.5   444.7    2113   445.6  2112.8   450.8
GR  2113   451.7  2112.6   452.2    2113   452.7    2113     457  2112.8   458.3
GR2113.2     459  2112.6   459.2  2113.2   460.1  2113.3   475.8  2113.6   476.5
GR2113.4   478.8  2113.3   489.3  2113.7   489.9  2113.3   490.4  2113.8   493.1
GR2113.8   496.5  2114.1   500.4  2113.8   508.1  2114.1   511.1    2115   515.2
GR  2116   517.4  2115.9   518.1    2117   520.4  2116.7   521.3  2132.9   561.5
GR2140.6   590.6    2141   620.2  2141.2   624.8  2140.7   632.5  2140.8   644.5
GR2140.9   645.7    2139   683.2  2138.6   687.5  2137.8   716.6  2137.6   716.8
HD54.518      30   286.9   511.1
```

CROSS SECTION #RM154.752

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X154.752      80   116.6   450.7  1292.6  1292.6  1292.6
GR  2160       0    2150    88.7  2140.2   116.6  2132.4   140.7  2129.4   151.2
GR  2116   163.7  2115.7   165.1    2114     166  2111.5   166.9  2112.1   168.2
GR  2110   169.1  2108.9     170    2108   172.2  2106.9   173.3  2104.3   177.6
GR2104.2   178.4    2103   179.3  2100.3   184.7  2099.7   187.8  2100.6   188.9
GR2099.8   189.9  2098.4     193  2098.6   194.1    2098     195  2096.2   202.4
GR2095.9   205.5    2099   233.4  2100.7     251  2101.1   252.1  2101.3   255.1
GR2101.7   255.3  2101.9   258.2  2102.4   258.4  2102.6   261.3  2103.1   261.5
GR2103.3   264.4    2105   270.7  2105.9   272.9    2109     279  2109.2   280.1
GR2110.3   282.1    2110   282.3    2111   284.3  2111.7   288.3  2111.6   289.5
GR  2112   290.3  2111.8   292.6  2112.3   293.7  2112.1   295.7  2112.6   301.9
GR2112.5   302.8  2113.3   302.9  2112.6   307.1  2113.3     308  2112.9     310
GR2113.8   310.2  2113.3   313.1    2114   313.4  2113.4   317.4  2114.1   317.6
GR2113.7   320.5  2114.3   320.7  2114.2   321.6  2112.6   322.5    2113   324.7
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GR2112.5   327.6  2113.1   327.9  2112.8   330.8  2115.3   354.9  2115.6   355.8
GR2117.1   364.2  2131.8   407.5  2130.9   410.6  2130.1     412  2134.7     417
GR2141.6   439.9    2142   450.7  2140.7   500.7    2141   502.7  2140.6   531.7
HD54.752      30   163.7   354.9
```

CROSS SECTION #RM154.979

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X154.979      80   179.6   560.5  1249.5  1249.5  1249.5
GR2135.4    80.4  2136.3   104.3  2135.2   105.5  2136.4   123.8  2135.8   154.6
GR2136.7   179.6  2133.4   210.3  2132.4   213.7    2130   226.7  2112.7   266.9
GR2113.2   267.9  2112.3   268.7  2113.5     269  2112.6   269.7  2111.8   274.2
GR2112.4   275.2  2111.4   276.1  2112.1   277.1  2109.9     286  2108.9   295.2
GR2108.4   297.1  2109.4   309.9  2108.9   310.6  2109.6   311.6  2108.7   313.5
GR2109.6   314.3  2109.3   319.7  2108.1   320.5  2109.9   321.6  2108.7   322.4
GR2110.2   323.4  2108.3   325.2  2110.2     326  2109.3     327  2110.1   328.8
GR2108.9   329.9  2110.3   330.6  2109.9   331.6  2110.3   332.4  2108.7   332.6
GR2110.3   333.5  2109.5   334.3  2110.4   335.4  2109.2   337.1  2110.4     338
GR  2109   339.7  2110.5   339.8  2109.2   341.6  2110.2   362.6  2111.8   370.8
GR2111.3   372.5  2111.9   373.5  2112.4   381.6  2111.9   382.4  2112.9   411.6
GR2113.3   412.5  2112.7   413.4    2114   435.4  2113.6   436.3  2113.6   447.1
GR  2114     448  2113.7     449  2114.4   450.8    2114   454.4    2113     458
GR2113.5   475.3  2114.6   484.3    2116     490  2119.6   499.9    2121     501
GR2121.1   502.6  2136.4     523  2137.5   552.7  2138.6   560.5  2138.2   584.1
GR2139.1   591.7    2140     627    2140   684.9  2139.6   698.5    2140   720.4
HD54.979      30   266.9   475.3
```

CROSS SECTION #RM155.072

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.072      81     150   484.5   497.3   497.3   497.3
GR2138.5       0  2136.6    21.2  2136.8    23.3    2131    34.4  2130.7    35.7
GR2130.8    42.3  2130.5    45.5  2131.1    48.4  2135.6    61.7  2135.9    70.1
GR2136.7    84.1  2135.7    91.4  2135.7    94.2    2136      95    2136    96.5
GR2136.4   101.3  2136.1   103.4  2136.9   105.6  2136.5   107.7  2137.3   107.9
GR2136.6   108.5  2136.9   110.4  2136.9   115.3    2137   116.2  2137.7   117.8
GR2136.9   118.1  2137.8   126.8    2138     150  2137.8   155.5  2128.7   169.2
GR  2119   200.6    2118   202.1  2116.5   204.9  2114.1     211  2113.2   213.9
GR2112.9   215.3  2112.3   221.3  2111.4   225.5    2111   228.5  2111.1   229.9
GR2110.9   243.4  2111.1   253.5  2111.6   257.8  2111.7   260.9  2111.2   280.1
GR2111.6   296.2  2111.4   302.1  2111.2     305  2111.5   309.3  2111.5   319.5
GR2112.2   331.4  2112.2   334.2  2112.6   335.7  2112.6   354.7  2112.5   357.8
GR2112.5   370.9  2112.8   378.2  2112.6   386.8  2112.8   392.9  2112.5   394.4
GR2112.3   397.1  2112.4   400.3  2112.8   403.2  2113.7   407.5  2114.5     409
GR2119.1   423.9  2119.3   425.2  2119.1   426.7  2119.7   428.3    2120   431.1
GR2120.7   433.9  2122.3   438.3  2123.8     443  2124.6   447.2  2133.6   466.8
GR  2137   475.9  2137.9   484.5  2138.2     508  2138.9   550.1    2139   589.5
GR2139.8   596.9
HD55.072      30   211.0   409.0
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CROSS SECTION #RM155.162

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.162      80   116.4   474.6   468.1   468.1   468.1
GR  2140       0  2139.6     3.7  2139.6     7.2  2138.8    14.7  2137.5    17.8
GR2133.4    33.4  2133.3    42.1  2137.7    46.4  2136.3    53.4  2138.2    86.1
GR2138.1   116.4  2136.4   124.9  2128.5   138.1  2127.3   147.5    2119     166
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GR2118.7   167.3  2118.6   168.4  2118.2   169.6  2117.7   170.3  2117.5   171.5
GR2116.6   173.5  2116.7   173.8  2115.2   177.6    2115   178.9    2114   181.9
GR2113.6   184.2  2113.2     185  2112.3   191.6  2112.3   196.4  2111.3   204.7
GR2110.9     213  2110.9   226.8  2111.1   229.9  2111.7   232.7  2112.1   249.4
GR2112.1   258.5  2112.3   259.7  2112.3   265.4  2112.5   271.4  2112.4   272.1
GR2112.7   275.7  2112.4   276.3  2112.1   278.1  2112.2   279.4  2112.1   285.5
GR2112.2   285.9    2112   286.6    2112   292.2  2112.1   292.9  2112.2   308.6
GR2112.3   309.8  2112.3   323.3  2112.8   337.8  2112.5   343.9  2112.3   345.9
GR  2112   354.3  2111.9   355.5  2112.1   356.2  2111.8   356.6    2112   357.4
GR2111.1   365.8  2111.1   368.8  2111.5   371.9  2113.4   378.2  2113.9   379.4
GR2116.4   387.4  2118.6   391.5  2119.9   392.7  2120.7   394.5    2122   396.8
GR2122.9   399.9  2123.7   403.1  2123.7   404.3  2124.7   410.4  2124.8   411.6
GR2136.6   433.9  2137.2   434.4  2137.8   440.9  2139.5   474.6  2139.3   549.1
HD55.162      30   181.9   379.4
```

CROSS SECTION #RM155.222

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.222      81   167.6   513.6   319.2   319.2   319.2
GR2133.4       0  2133.4    11.4  2133.8    14.1  2133.8    20.1    2131    33.5
GR2131.2    38.6  2136.7    57.5  2136.8    62.4  2139.8    75.5  2137.9    86.6
GR2137.3   117.4  2134.4   139.8  2136.5   158.3  2137.3   162.5  2137.6   167.6
GR2137.3   170.7  2137.1   175.7  2135.9   184.7  2135.6   186.2  2131.5   191.8
GR2129.5   195.1  2121.2   227.7  2120.2   230.7  2117.5   236.8  2116.6   237.5
GR2115.8   239.8  2114.9   242.9  2113.8   247.3  2112.9   251.5  2112.4   257.5
GR2111.7   264.9  2111.5   270.9  2110.6   276.5  2110.5   279.5  2111.2   283.8
GR2111.5   290.6  2112.1   293.7  2112.1   304.2  2112.8   307.6  2112.9   312.4
GR2112.5   314.8  2112.5     319  2112.8   323.9  2112.7   325.1  2113.6   337.5
GR2113.6   344.8  2113.4   347.1  2112.6   360.5  2112.6   367.8  2113.1     377
GR2112.8   385.2  2113.1   394.7  2113.2   401.9  2112.8   405.8  2112.8   409.1
GR2111.8   415.6  2110.2   420.9  2109.6   426.9  2110.9   431.2    2113   436.1
GR2114.8     439  2116.4   440.2  2121.8   447.7  2122.8   452.7    2123   454.6
GR2123.7   456.8    2125   465.2  2124.9   466.1  2130.2     480  2133.9   491.8
GR2134.6   494.6  2134.8   498.3  2135.8   503.2  2136.5   504.7  2136.7   507.3
GR2138.9   513.6  2138.8   529.9  2140.3   548.5  2139.3   634.7    2140   661.1
GR2139.9   688.3
HD55.222      30   242.9   439.0
```

CROSS SECTION #RM155.289

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.289      78   214.3   655.5   351.8   351.8   351.8
GR2134.1       0  2133.7     8.6  2133.2    11.4  2133.1    34.2  2132.9    39.1
GR2132.5    41.6  2132.1    69.7  2133.4   117.7  2133.2   137.5  2133.3     138
GR2133.5   145.5  2132.6   163.3  2132.7     173  2137.1   193.7    2138   195.3
GR2138.8   214.3  2137.9   222.3  2137.3   269.7  2137.6   278.6  2136.8   282.1
GR2137.1     284  2129.1   290.9  2129.2   293.8  2128.5   297.6  2129.6   312.6
GR2121.5   333.2  2121.2   337.4    2120   345.3  2118.9   351.8  2118.5   357.1
GR2117.9   358.2  2117.3   361.3  2116.7   362.4    2116   369.2  2113.9   375.2
GR2113.2   382.7  2112.1   389.9  2113.1   400.6  2113.1   406.8  2112.8   407.9
GR2113.2   416.1  2112.5   423.4  2112.5   427.6  2113.1     442  2113.4   453.7
GR2113.2   456.8  2113.6   461.7  2113.5   475.2  2114.5   480.5  2114.2   484.8
GR2114.3   495.8  2114.5   496.9  2114.8   515.8  2114.8   521.9  2114.6   532.4
GR2114.7   543.8  2114.6   548.1  2114.7   551.2  2115.9   557.5  2117.6   561.7
GR2118.6   563.6  2119.2   565.9  2119.8   566.6  2122.3     573  2124.1   582.3
GR2124.3   584.3    2132   597.3  2131.8     605  2141.9   652.1  2142.1   655.5
GR2141.5   672.8  2141.9   681.2  2142.5   682.1  2139.4   712.7  2137.9   780.2
```

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GR2137.8   831.6  2138.1   835.7  2138.4   846.1
HD55.289      30   361.6   561.7
```

CROSS SECTION #RM155.349

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.349      80   198.6   741.7   313.7   313.7   313.7
GR  2132       0  2132.2      .4  2132.3    18.6  2132.8    27.7  2132.3      50
GR2132.6    58.1  2132.8    84.8  2132.6    91.4  2134.1   144.7  2133.5     157
GR  2137   186.3  2140.4   198.6  2140.3   206.1  2128.3   258.2  2120.7   301.1
GR2121.1   301.3  2120.4   305.7  2119.6     307  2116.6   317.3  2115.6     329
GR2116.2   329.4  2114.3   343.6  2114.2   361.3    2115   370.1  2116.1   370.1
GR2114.2   375.9  2113.8   379.1  2113.1     395  2113.3   403.9    2114     413
GR2113.7   415.7  2114.1     416  2113.8   420.3  2113.8     435  2114.5   455.2
GR  2114   465.6  2114.3   481.8  2114.7   484.6  2114.8   496.4    2115   496.7
GR2115.4     504  2116.3   509.7  2116.7   509.9  2116.4     511  2117.2   511.1
GR  2117   513.9  2117.7   514.3  2117.3   518.2    2115   521.7  2115.2   523.2
GR2114.8   530.5  2115.8   534.9  2116.9     538  2119.5   542.2  2120.4   543.2
GR  2122   546.3  2124.2     557  2134.8   587.6  2135.5   601.1  2135.6   615.5
GR2136.2   616.3  2136.1   630.7  2136.7   637.1  2137.6   638.9  2137.4   640.8
GR2139.4   671.2  2139.1   677.8    2138   679.7  2148.4   741.7  2154.9   777.3
GR2155.1     782  2154.4     796  2153.9   797.5  2155.1   799.2  2156.7     804
GR2160.8   807.7  2162.3   810.8  2166.5   815.2  2175.9   828.8  2177.5   832.7
HD55.349      30   317.3   538.0
```

CROSS SECTION #RM155.414

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.414      80   191.4   575.8   342.3   342.3   342.3
GR2132.8       0  2132.7       1  2133.1    52.1    2133    61.2  2133.2    63.5
GR2134.1     105  2135.3   135.8  2136.4   145.4  2137.5   148.7  2137.3   158.9
GR2139.2   163.8  2139.6   169.8  2139.1   179.9  2139.9   191.4  2139.1   198.3
GR2138.8   207.9    2135   226.1  2133.4   230.2  2129.1   237.5  2128.9   246.7
GR2122.1   260.7  2116.4   270.3  2116.3   277.5  2114.6     291  2115.1   293.1
GR2115.2   299.4  2114.7   302.4  2112.8   309.6  2112.8   311.8  2113.7   317.8
GR2115.4     322  2115.4   326.3  2116.3   337.6  2116.4   342.7  2115.6   345.9
GR  2116   355.4  2116.1   365.6  2115.7   385.3  2114.6   419.4  2115.7   425.9
GR2116.1   426.7  2115.3   431.9  2114.7     433  2115.3   434.1  2115.2   435.2
GR2114.4   437.4  2115.1   438.3  2114.6   449.6  2113.4     460  2113.3   467.5
GR2113.7   475.5  2114.5   486.9  2114.4   492.2  2115.7   494.4  2118.2   505.7
GR2117.8   506.6  2118.8   507.7  2119.5   517.2  2124.5   535.7  2125.4   540.9
GR2127.8   549.1  2129.8   559.7  2134.3   568.2  2137.6   575.8  2137.3   577.7
GR2137.6   583.5  2137.3   595.5  2134.9   624.6  2134.6   625.2  2136.7   639.7
GR2137.7   695.2  2136.3   705.1  2145.1   725.4  2149.6     744  2155.6   757.8
GR2155.6   759.9  2154.8   773.6  2160.3     780  2166.5   790.1  2171.4   792.7
HD55.414      30   270.3   494.4
```

CROSS SECTION #RM155.479

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.479      81   178.6     658   341.7   341.7   341.7
GR2135.5       0  2136.4    40.2  2136.1   130.8  2135.7   131.9    2137   155.1
GR2140.6   178.6  2139.7     191  2137.3   200.6  2134.6   207.4    2132   212.9
GR2129.1   217.3  2129.2   219.8  2128.4   231.9  2116.3   260.9  2115.4   264.9
GR2114.3   276.3  2114.8   279.3  2114.5   287.3  2114.7   289.7  2115.7   296.1
GR  2117   301.5    2117   304.2  2117.5   308.7  2117.1   314.5  2115.8   323.2
GR2115.3   324.9  2115.8   325.4  2115.3   328.2  2115.6   336.6  2115.5   337.5
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GR  2115   371.7  2114.4   374.8  2114.2   380.4  2114.2   398.7  2113.8   405.2
GR2113.4   409.3  2113.5   412.3    2114   416.4  2114.8   419.5  2114.4   434.5
GR2114.7   444.3  2115.7   446.6  2114.5   453.6  2114.3   459.3  2113.9   461.6
GR2113.3   471.9  2115.6   476.7  2116.3     479  2116.5   481.6  2116.9   482.2
GR2116.4   484.7  2117.1   485.3  2117.5     487    2117   488.8  2117.8   489.5
GR  2119   496.7  2119.6   505.5  2120.1   506.9  2120.5   510.1  2123.9   524.6
GR2124.1   527.8    2132   549.1  2133.1   556.3  2135.2   561.2  2135.3   564.9
GR2138.8   572.6  2138.9   572.8  2136.6   624.6  2142.8     658  2155.2   698.1
GR2153.9   701.7  2156.8   707.5  2156.8   709.2  2156.4   709.4    2157   722.2
GR2157.3   722.3    2157   733.4  2168.9   748.7  2171.9   753.6  2183.4   761.9
GR2185.5   774.3
HD55.479      30   260.9   490.5
```

CROSS SECTION #RM155.540

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.540      81   198.6   671.2   320.7   320.7   320.7
GR  2132       0  2132.2      .4  2132.3    18.6  2132.8    27.7  2132.3      50
GR2132.6    58.1  2132.8    84.8  2132.6    91.4  2134.1   144.7  2133.5     157
GR  2137   186.3  2140.4   198.6  2140.3   206.1  2128.3   258.2  2120.7   301.1
GR2121.1   301.3  2120.4   305.7  2119.6     307  2116.6   317.3  2115.6     329
GR2116.2   329.4  2114.3   343.6  2114.2   361.3    2115   370.1  2114.2   375.9
GR2113.8   379.1  2113.1     395  2113.3   403.9    2114     413  2113.7   415.7
GR2113.8   420.3  2113.8     435  2114.5   455.2    2114   465.6  2114.3   481.8
GR2114.7   484.6  2114.8   496.4    2115   496.7  2115.4     504  2116.3   509.7
GR2116.4     511    2117   513.9  2117.7   514.3  2117.3   518.2    2115   521.7
GR2115.2   523.2  2114.5   524.6  2114.4   527.6  2114.8   530.5  2115.8   534.9
GR2116.9     538  2119.5   542.2  2120.4   543.2    2122   546.3  2122.5   549.5
GR2122.5   550.9  2123.1     554  2124.2     557  2134.8   587.6  2135.5   601.1
GR2135.6   615.5  2136.2   616.3  2136.1   630.7  2136.7   637.1  2137.6   638.9
GR2137.4   640.8  2139.4   671.2  2139.1   677.8    2138   679.7  2148.4   741.7
GR2154.9   777.3  2155.1     782  2154.4     796  2153.9   797.5  2155.1   799.2
GR2156.7     804  2160.8   807.7  2162.3   810.8  2166.5   815.2  2175.9   828.8
GR2177.5   832.7
HD55.540      30   307.0   542.2
```

CROSS SECTION #RM155.606

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.606     106   152.3   479.5   345.5   345.5   345.5
GR  2138       0  2138.3    12.2  2138.6    14.1  2138.5    21.8    2139    38.1
GR2136.1    77.4  2136.6    91.2  2136.1   116.6  2136.1   137.4  2136.8   142.5
GR2136.9   145.3  2137.8   152.3  2136.6   186.3  2133.2   204.1  2129.3   216.6
GR2120.8   237.9  2120.6     238  2120.2     241  2119.2   244.4  2118.1   247.5
GR2117.9   247.5  2117.8   247.7  2116.8   251.2    2116   254.4    2116   257.5
GR2115.4   257.6  2115.3   260.8    2115   264.1  2114.7   267.3  2114.6   270.6
GR2114.2   270.6    2114   273.8  2114.2   273.9  2113.8     274    2114   277.3
GR2113.8   277.4  2113.5   277.4  2113.3   283.9  2113.2   283.9  2112.8     287
GR2112.9   287.1  2112.1   293.5  2111.8   296.8  2111.8   296.9    2111   300.2
GR2110.9   303.7  2111.4   306.8  2110.8   306.9  2111.3   310.1  2111.2   310.1
GR2110.9   316.6  2110.6   319.9  2109.4   329.6  2108.8   333.1  2108.7   333.1
GR2106.8   339.6  2106.5   339.6  2106.5   339.7  2106.3   339.8  2103.1     346
GR2103.3   346.1  2100.5   352.6  2099.1   355.8    2099   355.8  2099.2   355.9
GR2097.5   365.9  2097.6   365.9  2097.5   369.1  2097.7   369.1  2100.3   385.6
GR2100.2   385.6  2105.1   398.5  2107.3   401.9  2108.6   405.1  2109.5   408.5
GR2110.8   411.9  2112.5   415.1  2112.2   415.1  2112.6   415.2    2116   421.6
GR2116.3   421.6  2117.7   424.8  2119.9   431.3    2120   431.4  2119.7   431.5
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GR2121.2   434.6  2120.9   434.6  2121.1   434.8    2122   438.1  2121.9   438.1
GR2121.7   438.2  2122.6   441.3  2133.5   452.9  2134.5   461.1  2152.8   479.5
GR2152.9   482.8  2152.9   484.7  2152.8   502.7  2173.7   526.3  2178.7   539.4
GR2183.2   548.9  2194.6   568.6  2200.8     585  2218.5   627.3  2220.8   630.8
GR2231.5   663.1
HD55.606      30   237.0   441.3
```

CROSS SECTION #RM155.674

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.674      80   177.3   496.3   358.6   358.6   358.6
GR2136.8       0  2136.8     6.7  2135.7    10.9    2137    83.2  2136.7    83.3
GR2136.3    94.6  2137.1   108.4  2137.8   157.6  2138.6   160.9  2138.3   177.3
GR2136.2   201.3  2131.5   207.4  2119.3   247.8  2118.1   253.6  2114.6   268.5
GR2114.9   270.4  2113.8   278.8  2111.6   301.4  2110.3   316.3  2110.6   319.2
GR  2110   319.4  2110.1   321.4  2108.6   333.8  2105.8   340.3  2106.5   343.1
GR  2105   343.4  2105.4   346.2    2104   346.5  2104.4   349.2  2103.5   349.6
GR2104.2   352.5  2104.4   358.6  2103.9   362.7  2101.3   370.1  2102.5   370.3
GR2101.2   373.2  2102.8   374.5  2100.6   376.3  2100.2   377.3  2101.4   377.6
GR2099.6   378.5  2098.7   381.6  2098.1   386.7  2098.2   393.9  2099.8   394.3
GR2099.3   395.2  2098.9   397.2    2102   404.4  2105.1   408.8    2106   414.6
GR2106.7   414.9  2106.7   416.7  2109.2   425.1  2110.4   425.4  2110.3   426.4
GR  2115   436.6  2115.4   438.6  2116.5   438.8  2116.6   441.5  2117.7   442.8
GR2119.4   448.8    2120   449.3    2122   459.7  2122.2   464.6  2124.4   465.6
GR2124.7   466.5  2148.1   496.3  2147.9   508.4  2154.4   519.5  2187.5   560.4
GR2193.1   569.6  2198.3   576.9  2206.1     597  2209.3   602.6  2214.7   618.1
GR2219.4   625.8  2224.1   638.8  2228.3   643.8  2241.7   664.2  2258.2   699.8
HD55.674      30   247.8   448.8
```

CROSS SECTION #RM155.739

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.739      80     144   516.3   336.7   336.7   336.7
GR2139.8       0  2139.8      16  2133.7    31.4  2133.5    33.9  2136.1    68.1
GR2136.6    78.5  2136.7    88.8  2139.1   122.1  2139.2   128.3  2140.3   131.9
GR2140.4     144  2139.8   147.8  2140.2   151.1  2139.9   157.5  2139.2   165.2
GR2139.3   167.6  2138.2   175.3  2138.2   177.6  2132.2   188.7  2129.3   192.8
GR2120.5   248.9  2119.6   252.8  2120.2   253.4  2119.8   254.6  2119.5   260.1
GR2118.9   265.2  2118.3   273.6  2118.4   274.7  2117.1   281.6  2117.4   281.9
GR2116.5   289.3  2114.5   295.6    2114   298.4  2111.9   317.6  2112.3   319.7
GR2111.1   347.2  2111.1   348.5  2110.3   358.5  2109.2   364.6  2108.1   368.2
GR2107.7   374.7  2106.3   381.2  2106.5   381.7  2105.8   382.2  2106.3   382.9
GR2105.9   383.9  2106.4   384.7  2104.7   389.4  2104.7   391.3  2103.4   393.9
GR2102.9   401.3  2103.3     403    2103   405.7  2103.9   407.4  2103.4   410.4
GR2103.6   413.2  2104.8   414.8  2105.4   420.5  2108.9   431.2  2108.8   431.9
GR2109.3   435.7  2108.8   436.7  2109.4   438.3  2109.3   439.7    2112   448.8
GR2118.7   459.3  2119.4   461.1  2119.5   462.2  2121.7   469.3  2122.9   475.1
GR2131.3     482    2140   497.2  2142.2   508.7  2142.5   516.3  2141.8   526.3
GR2141.8   530.4  2145.4     537  2148.6   544.9    2155     549  2162.3   559.4
HD55.739      30   248.9   459.3
```

CROSS SECTION #RM155.803

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.803      80      85     510   338.8   338.8   338.8
GR2139.8       0  2138.8    11.1  2136.8    20.7    2137    34.8  2138.7    64.2
GR2138.4    67.5    2139    70.1  2138.6    74.9  2139.7      85  2138.6    89.8
```

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GR2139.2   107.2  2138.1     120  2137.1   123.2  2131.5   131.5  2128.2   141.7
GR2128.6     142  2128.7   148.1  2127.8   151.9    2128   157.1  2118.9   210.8
GR2117.2   212.7  2117.1     215  2116.1   219.5    2116   233.8    2115   238.3
GR2114.5     243  2113.9   254.5  2113.1   263.8  2112.4   280.4  2112.1   289.4
GR2112.1   301.4  2111.8   308.2  2112.1   314.9  2111.7   333.8    2112   340.5
GR2112.7     350  2113.6   357.1  2113.5     359  2112.8   359.6  2110.8   368.9
GR2111.5   373.3  2111.4   375.5  2112.6   382.2  2113.7   384.8  2113.7     387
GR  2115   400.9  2115.1   408.1  2116.5   414.9  2118.5   421.8  2120.1   433.7
GR2121.9   445.4    2122   447.7  2123.5     457  2123.7   459.3  2135.7   476.7
GR2133.1   484.6  2133.5   484.7    2133   487.3  2133.9   491.5  2135.9   493.4
GR  2136   495.1  2138.9   500.8  2145.2     510  2140.1   523.5  2139.8   530.3
GR2139.5   530.6  2140.1   533.6  2139.7   540.1  2139.7   554.2  2139.9   554.4
GR2139.4     558  2139.6   560.2  2138.3   566.7  2148.6   589.5  2152.7     596
GR2152.6   596.5  2157.9   611.7  2161.1   614.2  2161.9   618.4  2164.3   625.5
HD55.803      30   212.7   414.9
```

CROSS SECTION #RM155.869

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.869      80   208.5     596   348.2   348.2   348.2
GR2134.6       0  2134.3    12.3  2135.3    46.2  2134.5   106.5  2135.3   117.1
GR2134.6   129.7  2135.6   141.2  2136.1   155.5  2138.6   167.3  2139.8   181.3
GR2139.4   196.9  2139.8   205.1  2140.6   208.5  2140.3   233.6  2134.9   246.2
GR2132.8   252.6  2128.1   264.2  2121.8   302.8  2120.1   309.3  2117.4   321.1
GR2116.4     325  2115.2   335.6  2115.3   344.8  2115.2     346  2114.3   350.6
GR2113.8   356.4  2113.6   367.7  2111.9   379.5  2111.7     380  2111.5   388.7
GR2111.2   389.4  2111.4   393.2  2111.4   403.8  2111.2     413  2111.2     419
GR2110.6   420.2  2110.4   421.5    2110   422.2  2109.4   431.3  2108.4   437.1
GR  2109   440.5  2108.7   449.7  2108.1   457.6  2108.7   464.8  2109.2   466.8
GR2109.9   481.2  2109.5   483.2  2109.8   489.2  2112.6   502.7  2113.9   505.6
GR2116.9   519.1  2118.8   523.2    2119   526.3  2119.6   527.8  2119.7     529
GR2122.8   545.4  2129.8   554.3  2130.9     560  2139.4   569.5  2143.6   583.7
GR  2144   595.5  2144.5     596  2142.3   614.6  2141.7   683.6  2142.1   699.2
GR2142.2   706.2  2143.7   720.9  2144.9   727.9  2145.4   743.6  2145.3   757.3
GR  2146   765.1  2146.1   768.2  2148.5   777.1  2148.4   782.2  2149.5   787.7
GR2150.6   790.9  2150.6   797.6  2152.1   803.1  2153.5   819.1  2153.9   819.7
HD55.869      30   321.1   523.2
```

CROSS SECTION #RM155.933

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.933      80   220.8     548   334.3   334.3   334.3
GR2134.9       0  2134.7       3  2134.8    17.5  2135.3    36.4  2136.1    55.1
GR2135.8    58.4  2136.2      67  2136.2    76.3  2136.5    89.8  2137.2    97.2
GR2137.6   109.4  2138.4   120.4  2138.7   132.3  2138.1   143.1  2138.6   148.4
GR2138.6   160.3  2138.2   165.8  2138.7   201.4    2140   220.8    2140   224.1
GR2139.2   232.7  2139.4   244.9  2139.6   244.9  2138.9   252.1    2133     270
GR2127.8   290.9  2118.9   304.7  2118.7   305.3  2116.9   317.2  2116.3   317.9
GR2116.1   319.1  2115.5   319.8    2113   334.4  2112.8   336.3  2112.7     339
GR  2112   349.3    2112     361  2111.3   369.1  2111.3     381  2111.4   384.6
GR2111.4   389.9  2110.8   408.3  2109.9     415  2108.8   420.2  2107.8   426.7
GR2107.1   428.1  2104.3   435.5  2103.4   441.3  2103.1   441.8  2102.9   446.5
GR2103.1   465.4  2103.4   467.6  2103.9   468.1  2104.6   471.4  2109.4   481.3
GR2112.1   485.8  2113.9   487.8    2114   488.4  2115.1   489.2  2115.6   490.4
GR2116.3   491.1  2116.5   492.3  2117.8   493.7  2117.9   494.9  2118.5   495.8
GR2119.2   496.4    2119   497.5  2119.6   498.2  2119.5   499.4  2120.6   500.9
GR2130.6   524.8  2132.7   527.4  2137.9   535.1  2140.3   542.7  2140.5     548
```

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GR2140.4     559  2139.8   564.7  2150.1   576.5  2156.3   585.8  2163.7   590.1
HD55.933      30   304.7   494.9
```

CROSS SECTION #RM155.997

```
NC .0291   .0291   .0331
NV     24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X155.997      80   255.4   585.4   336.5   336.5   336.5
GR2135.3       0  2135.3    27.5  2137.7   127.9  2138.1   134.3  2137.3   154.4
GR2138.1   166.6  2137.7   179.9  2138.2   184.1    2138   217.4  2137.3   229.6
GR2137.3   233.2  2138.1   239.2  2140.7   251.6  2140.6   255.4  2137.4   270.9
GR  2134   297.9  2134.3   299.2  2129.2   308.2  2130.2   309.6  2120.1   336.3
GR2119.6   341.7  2119.9   345.5  2119.7   347.4  2118.9   350.9  2115.9   358.2
GR2114.2   365.3  2113.9   374.5  2112.9   388.2    2113   400.2  2112.2   426.4
GR  2112   430.8  2110.1   441.2  2110.2   443.8  2108.1   447.4  2107.2   448.3
GR2107.1   449.3  2107.4     450  2105.1   459.2  2104.7   465.7  2103.3   478.3
GR2102.9   479.5    2103   481.1  2102.6   481.1  2103.1   487.5  2102.9   488.7
GR2103.7     492  2109.4   508.4  2110.4   513.9  2112.2   517.4  2111.9   518.4
GR  2113     521  2115.8   524.1  2116.1   525.7  2117.3   526.9    2119   529.2
GR2119.1   530.2  2120.2     532  2123.4   542.9  2124.2   548.4  2131.5     560
GR2133.7   568.4    2137   573.6  2138.2   574.6  2140.6   585.4  2140.6   597.4
GR2139.4   602.3  2140.2   604.1  2139.7   607.8  2145.4   615.6  2143.8   623.8
GR2148.5   630.5  2150.2   633.5  2160.2   643.7  2179.1   664.4  2187.3   683.8
GR2188.4   691.5  2190.6   692.7  2197.8   710.6  2197.6   712.5  2197.5   731.8
HD55.997      30   336.3   532.0
```

CROSS SECTION #RM156.066

```
NC .0291   .0291   .0331
NV     24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.066      80      32     423   362.4   362.4   362.4
GR2140.3       0  2140.3      32    2139    49.9  2136.3    70.4  2135.4    73.9
GR2135.3    86.3  2134.7    96.9  2134.4    98.8  2127.4   114.7  2128.7   125.4
GR2120.7   132.5  2120.9   132.8  2120.1   133.6  2120.4   134.1    2115     144
GR2115.2   144.4  2113.1   154.8  2112.6   158.7  2112.1   163.4  2111.9   169.3
GR2111.9   176.9  2111.1   190.1  2111.1   192.6    2111   193.1    2111   204.3
GR2111.1   204.7  2111.1     219  2110.7   225.5  2110.7   241.5  2110.5   247.4
GR2110.5     253  2110.8   263.4  2110.8   271.8  2110.9   272.2    2110     288
GR2111.2   299.9  2111.3   308.6    2111   316.3  2110.4   320.2  2111.4   323.5
GR2112.4     325  2112.3   326.5  2112.9     328  2113.2   331.1    2113   332.4
GR2113.8   335.2  2116.3   339.5  2117.8   342.5  2118.1     344    2121   352.9
GR2122.4   358.7  2122.4   360.3  2123.7   364.6  2136.1   380.3  2137.1   402.3
GR2139.9   412.4    2144     423  2143.8   435.5  2140.9   444.1  2138.8   449.1
GR2136.1   461.5  2135.1     464  2134.6   496.7  2134.8   513.4  2134.6   522.4
GR2134.9   528.1  2134.9   538.2  2134.7   539.8  2134.7   556.8  2134.3   564.4
GR2134.3   569.6    2134   581.1  2134.8   595.6  2134.8   602.5  2134.3   608.3
GR2136.1   611.3  2136.6   615.2  2138.4   619.5  2140.9     628  2160.9   674.9
HD56.066      30   144.0   339.5
```

CROSS SECTION #RM156.135

```
NC .0291   .0291   .0331
NV     24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.135      80   152.6   596.9   363.8   363.8   363.8
GR2134.3       0  2134.1      .9    2135      14  2138.1    22.3    2139      41
GR2139.5    65.8  2139.2    77.7  2139.6    82.5  2139.2    84.8  2139.2      90
GR2139.5    93.2  2138.2   102.1  2137.9   115.9  2141.2   152.6    2141   153.8
GR2140.4   177.2  2137.5   219.6  2134.6   253.4  2134.3   259.5  2130.9   271.8
GR2129.5   279.4  2128.3   286.9  2119.4   297.5  2117.3   302.8  2115.5     309
GR2112.8   321.3    2112   321.8  2112.1   324.5  2111.6   324.9  2110.7   334.9
```

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GR2110.5   335.2  2110.3   339.5  2108.8   345.2  2108.6   353.8  2108.8   355.6
GR2109.8   362.7  2109.4   363.2  2109.4   384.9  2108.8   399.3  2108.8   402.4
GR2109.2   421.5  2111.6   432.7  2112.4   440.7  2112.6   446.1  2112.3     447
GR2111.8   451.6  2111.8   456.6  2111.6   466.8  2111.1     475  2109.9   486.7
GR2110.7   501.1  2111.6   506.5  2112.2   507.6  2112.3   509.5  2113.3   512.4
GR2116.3   517.8  2121.1   531.4  2121.4   533.7  2128.6   552.6  2129.7   557.3
GR2129.2   557.9  2130.4   561.5  2130.5   563.6  2131.1   563.8  2137.5   571.5
GR2144.2   594.7  2144.4   596.9  2144.2     607  2144.4   607.9  2144.1   610.8
GR2144.2     615  2138.4   626.5  2138.3   629.6  2136.1   638.4  2133.7   643.4
GR2133.7   652.8  2134.1   667.9  2133.8   684.4  2133.8   698.4  2133.4   700.3
HD56.135      30   309.0   517.8          2086.2  321.8    506.5       0       0
```

CROSS SECTION #RM156.213

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.213      80    58.3   554.3   410.6   410.6   410.6
GR2139.7       0  2139.7    11.9  2138.9    22.3  2139.5    39.2  2140.5    46.4
GR2140.4    58.3  2139.9    60.7  2139.1    93.1  2138.5    98.6  2136.4     137
GR2136.4   151.5  2121.6   181.2  2120.8   184.5  2119.2   189.7  2115.4   200.6
GR2114.2   202.5    2110   219.2  2108.3   228.1  2107.5   235.9  2107.5   241.1
GR2108.7     252  2109.2   262.4  2109.4     263  2110.1   268.8  2110.5   278.5
GR2110.2   295.8  2110.2   306.8  2110.1   309.2  2109.6   313.2  2108.8   329.9
GR2108.8   343.5    2109   347.8  2108.3   369.1  2108.1   370.3  2108.8   376.3
GR2109.5     380  2111.3   385.2  2112.3   391.6  2115.9   400.9  2119.3     404
GR2121.1   408.3  2122.5   415.3  2130.1   447.1  2133.2   473.2  2134.2   484.9
GR2135.2   502.8  2137.2   527.2  2138.1   533.4  2142.2   540.3  2145.1   554.3
GR2144.9   563.4  2144.4   567.5  2139.4   578.7    2139   583.6  2137.6   590.2
GR2134.2   599.8  2129.5   604.9  2130.3     608  2128.9   613.3  2128.5   617.7
GR2129.2   618.7  2129.3   624.1  2129.8   625.7  2128.2   631.3  2126.7     633
GR2128.8   637.3  2129.2   643.7  2128.4   645.1  2124.7   658.2  2125.5   661.7
GR  2125   665.6  2122.1   671.4  2122.8   674.3  2121.9   680.8  2121.7   685.8
GR2122.9   689.1  2124.2   697.8  2126.3   702.9  2127.6   712.4  2129.2   742.2
HD56.213      30   202.5   400.9          2086.2  219.2    380.0       0       0
```

CROSS SECTION #RM156.286

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.286      80   214.5   663.2     389     389     389
GR2134.6       0  2134.4    22.2  2137.8    85.5  2137.2    93.5    2137    99.9
GR2138.4   123.9  2139.8   131.9  2139.5   133.4  2140.2   149.6    2140     195
GR2140.7   198.2    2141   214.5  2140.3   224.1  2140.9   229.9  2138.6   238.7
GR  2137   258.5    2137   265.6  2134.9     272  2135.7     275  2136.3   286.8
GR2136.3   297.5  2133.1   309.9  2130.6   325.5  2121.6   332.6  2120.5   338.4
GR2117.4   346.8  2116.5   347.8  2116.3   349.3  2114.8   351.8  2114.4   353.8
GR2113.9   354.2  2112.8   359.4  2112.8   361.5  2112.4   362.7  2112.9     366
GR  2116   376.9  2115.8   377.5  2115.8   379.4  2112.3   387.2  2111.4   388.5
GR2110.5   391.8  2109.9     393  2109.6   397.3  2110.1   400.7    2111   407.9
GR2112.7   416.3  2112.7   418.2  2113.1     420    2111   434.9  2109.5   443.8
GR2108.9   446.4  2108.3   447.7  2106.8   454.7  2106.5   463.8  2105.9   473.5
GR2106.1   476.5  2110.6   499.9  2108.8   508.9  2108.9     512    2118     532
GR2118.1   535.1  2122.5   551.2  2122.2     552  2122.9   555.8  2129.1   566.1
GR2129.2   581.7  2130.7   587.9  2137.4   611.4  2140.8   647.7  2144.2   663.2
GR2143.8     677  2140.1   690.4  2133.3   719.9  2132.9   728.8  2133.7   742.6
GR2132.6   840.8  2131.7   859.3  2131.9   859.6  2131.1   897.3  2131.3   906.4
HD56.286      30   346.8   532.0          2086.2  351.8    512.0       0       0
```

CROSS SECTION #RM156.351

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.351      84     229   617.9   341.8   341.8   341.8
GR2133.8       0  2133.8     6.1  2134.3     9.6  2134.1    26.5  2134.6    38.8
GR2134.6    44.6  2136.1    78.9  2135.9    79.5  2136.1    83.5  2137.3    95.6
GR2137.5   105.3  2138.1   111.7  2140.2   166.4    2140   169.1  2140.2   184.1
GR2141.2   190.7  2141.3   192.9  2140.3   210.4  2141.4   215.8  2141.3     229
GR2137.3   253.2  2137.3   260.7  2136.8   265.4  2130.7   277.3  2122.9   303.3
GR2121.5   307.6  2120.5   310.3  2118.3     314  2116.7   321.2  2116.4   330.2
GR2115.8   333.9  2115.5   344.8  2114.4   354.1  2113.3   364.8  2111.9   373.8
GR2112.1   374.9  2111.6   376.5  2111.6   380.8  2111.8   383.5  2111.8   387.4
GR2110.5   397.1  2110.7   398.1  2110.4   400.2  2110.4   408.6  2109.8   418.1
GR2110.2   434.4  2109.9   447.3  2109.7   448.3  2109.7   456.4  2109.5   457.4
GR2109.1   461.9  2109.4   463.6  2109.2   464.4  2109.2   471.6  2108.9   480.2
GR2108.6   493.6  2109.9   501.9  2109.9   503.3  2110.4   504.3  2111.2   509.9
GR2112.1   511.5  2112.4   513.6  2118.6   524.3  2119.7   526.6  2122.3     536
GR2129.5   565.4  2132.5     572  2138.1   595.5  2143.8   617.9  2144.1   624.5
GR  2144   626.6  2141.6   638.5  2138.9   646.5  2136.7   654.8  2136.8   656.8
GR2132.1   728.6  2132.3   734.8    2132   739.8  2130.5   776.6  2130.7   781.1
GR2130.1   787.1  2130.4   793.1  2129.9   830.9  2129.7   835.1
HD56.351      30   321.2   524.3          2086.2  344.8    513.6       0       0
```

CROSS SECTION #RM156.399

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.399      80     280   687.8   253.5   253.5   253.5
GR2133.1       0  2133.8     3.2  2133.8     4.7  2133.5     5.7  2133.5      16
GR2133.9    77.2  2134.8   127.3  2134.5   130.6  2135.1   155.1    2135   155.3
GR  2136   166.8  2137.3   190.1  2138.6   201.9  2139.1   217.9  2138.5   226.4
GR2139.2   230.1  2140.2   242.7  2140.4     260  2141.4     280  2140.6   317.3
GR2136.7   330.6  2134.9   344.9  2132.6   351.5  2129.9   354.1  2122.7   378.9
GR2121.5   385.5  2120.9   386.7  2118.9   393.7  2118.4   396.4  2118.5   397.6
GR2117.7   403.4  2117.5   409.8  2117.5   415.7  2117.2   417.6  2117.4   419.1
GR2116.9   420.7  2117.1   422.1  2116.3   429.1  2115.1   434.3  2113.5   439.4
GR2112.5   447.3  2112.1   453.7    2112   462.7  2111.4   467.7  2110.9   477.4
GR2108.4   494.1  2107.9   498.8  2107.6   508.9  2107.6   512.8  2106.5   550.7
GR2106.2   553.4  2108.6   567.4  2112.5   577.7  2112.7   579.2  2114.5   585.5
GR2116.1   589.3  2121.7   600.8    2123   607.2  2123.3   609.4  2129.6   635.3
GR2134.4   639.4  2135.5   649.8  2139.2   663.4  2139.4   665.1  2143.1   675.6
GR2143.4   679.7  2143.6   687.8  2143.3   701.4  2142.8   706.7  2138.9   713.3
GR2138.5     717  2137.9   729.4  2133.8   739.7  2130.8   781.5  2131.2   785.4
GR2130.2   792.4  2129.5     818  2129.7   821.5  2129.3   845.6  2129.6   982.4
HD56.399      30   393.7   600.8          2086.2   434.3   585.5       0       0
```

CROSS SECTION #RM156.454

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.454      80     228   590.1   288.3   288.3   288.3
GR2133.7       0  2133.6     4.7  2134.7    65.1  2135.1    69.2  2135.5    93.4
GR2135.9   101.2    2138     116  2138.4   128.2  2137.7   139.7    2140   155.4
GR2140.4   162.2  2140.6   179.5  2141.8   188.6  2141.8   193.8  2140.6   205.7
GR  2142     228  2138.1   237.2  2136.1   251.9  2133.3   259.3  2130.2   269.4
GR2122.5   290.6  2121.6   295.2  2118.9   302.8  2117.8     304  2116.4   309.4
GR  2114   322.8  2113.6   328.5  2111.9   369.2  2111.6   378.8  2111.3   381.9
GR2109.4   394.3  2108.2     398  2106.1   401.3  2105.6   404.6  2105.6     431
GR2105.7   434.7  2105.4   444.4  2105.1   447.7  2102.8   455.9  2102.5   459.9
GR2102.9   462.9  2104.1   465.6  2104.8   468.3    2106   470.2  2107.5   476.5
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GR2108.6   479.8    2110   483.1  2113.4   490.1    2115   491.6  2117.5   496.5
GR2121.3     505  2122.9   512.6  2134.3   534.2  2133.5   543.1  2138.9   562.1
GR  2139   568.7  2141.3   574.9  2143.8   590.1  2143.9   593.8  2141.5   606.6
GR2138.9   608.7  2138.9   611.4  2138.2   614.9  2137.4   626.8  2137.4   628.7
GR2136.5   632.8  2135.3   650.7  2135.5   657.5  2136.1   666.6  2137.2   669.7
GR  2134     693  2134.1   709.3  2132.6   745.3    2132   749.5  2132.1   759.1
GR2130.3   771.1  2129.6   774.2  2130.4   781.8  2130.2     788  2129.9   790.3
HD56.454      30   302.8   505.0          2086.2   322.8   490.1       0       0
```

CROSS SECTION #RM156.504

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.504      80   227.5   630.6   265.6   265.6   265.6
GR2134.3       0  2134.8       9  2134.5    12.3  2134.7    14.4  2134.9    26.7
GR2135.1      28  2135.9    57.3  2135.9    66.6  2137.1     104  2137.8   138.2
GR2138.6   140.3  2138.1   141.1  2138.4   141.6  2139.2   166.2  2138.6   171.9
GR2138.8   174.3  2138.3     184    2139   189.1  2137.9   198.9  2138.1   203.3
GR2140.9     218  2141.6   227.5  2140.2   276.8  2136.4   313.3  2129.8   324.1
GR  2122   346.4  2119.9   357.2  2117.5   366.6  2117.3   368.5    2117   369.6
GR2116.9   372.7  2113.8   403.7    2113     409  2111.8   422.6  2111.1   429.8
GR2106.7   445.1  2106.3   452.5  2105.4     464  2104.2   473.3  2104.1   476.3
GR2104.2   479.5  2104.7   483.5  2106.5   494.4  2108.6   503.7    2109   504.7
GR2111.6   513.9  2111.9   515.8  2114.1   525.1  2116.7   533.6  2118.2   537.7
GR2121.1     547  2124.2   553.4  2124.2   556.4  2124.9   556.6  2124.7   557.4
GR2132.4   577.6  2132.4   580.1  2134.9   588.8  2136.4   595.8  2137.8   609.6
GR2142.5   630.6  2141.9   645.1  2142.5   651.2  2142.3   652.7  2144.2   657.4
GR2144.4   659.3    2148   671.4  2149.3   683.7  2149.9   685.4  2151.3   696.2
GR2151.2   697.7  2152.7   701.1  2155.9   726.4  2158.2   751.9  2158.3   762.7
GR2158.9   762.9    2159   765.4  2159.5   766.5  2159.6   790.5  2159.5   791.3
HD56.504      30   346.4   547.0          2086.2   366.6   533.6       0       0
```

CROSS SECTION #RM156.563

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.563      82   657.3  1003.7   312.2   312.2   312.2
GR  2138   533.1  2140.3   593.8  2138.7   621.4  2137.4   656.5  2138.8   657.3
GR2138.1     670  2117.8   725.3  2114.1   735.3  2112.8   742.5  2111.8     760
GR2111.6   777.7  2111.2   787.2  2111.7   788.1  2111.6   789.1  2109.8   792.1
GR2111.1   793.4  2109.7   795.3  2111.1   796.3  2110.2   797.4  2111.5   798.4
GR2109.4   801.6  2110.7   802.5  2109.2   802.7  2109.8   803.7  2109.4   804.8
GR2110.8   805.6  2109.2   805.8  2109.7   807.7  2110.8   808.8  2110.9   810.9
GR2109.6     813  2109.6   816.2  2108.5   819.3  2108.8   820.2  2107.6   823.4
GR2108.2   824.4  2107.4   825.5  2108.9   826.5  2107.1   828.6  2108.7   829.7
GR2108.3   830.5  2106.2   832.7    2108   833.7  2106.3   835.8  2107.6   836.9
GR2106.3     839  2105.5   839.8  2106.6   840.9  2105.3     843  2103.6   860.8
GR  2104   867.9  2104.8   868.1  2104.5     869    2105   870.3  2108.5   887.8
GR2109.1   888.6  2108.5   889.9  2110.2   891.8  2109.3   892.9  2111.2   893.1
GR2110.4   893.9  2111.3     895  2110.1   895.8    2112     896  2111.2   897.1
GR  2112   897.9  2110.9     899  2112.4   899.2  2113.5   910.6  2115.4   913.5
GR2113.9   913.6  2117.5   925.6  2128.5   963.4  2129.5   968.9  2129.4   970.4
GR  2134   977.5  2141.4  1003.7    2141  1042.8  2139.7  1071.3    2140    1084
GR2139.6  1117.8  2138.9  1122.4
HD56.563      30   725.3   925.6
```

CROSS SECTION #RM156.626

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
```

```
X156.626      80   592.3  1017.1   331.7   331.7   331.7
GR2137.4   445.7  2140.9   460.8  2141.6   462.1  2141.8   477.8  2141.2   478.2
GR2141.5   480.9  2139.1     493  2140.9   592.3  2139.6   598.8  2119.4   662.5
GR2119.8   664.2  2119.1   665.7  2119.6   667.1  2117.7   674.3  2116.9   675.8
GR  2117   677.5  2116.4     679  2116.1   683.5  2115.9   693.6  2115.7   695.8
GR2115.4   707.6  2115.1   709.8  2114.8   722.1  2114.9   722.9  2114.7   737.3
GR2114.9     739  2114.7   740.1  2114.7     753  2114.6   753.7  2114.8   759.4
GR2113.2   786.5  2112.9   787.6  2113.3   789.1  2113.1   789.7  2113.1   799.5
GR2113.4   800.5    2113     802  2113.6   804.3    2113   805.8  2113.7   806.9
GR2114.1   820.5  2113.2     822  2114.2   822.6  2114.3     834    2113   835.5
GR2114.3   837.2  2112.9   838.7    2113   839.3  2113.8   840.4    2113   842.1
GR  2113   843.2  2113.7   844.2    2113   845.7    2113   846.8  2113.9   847.4
GR2113.6   856.5  2113.7   867.3  2113.5   870.1  2114.3   879.2  2114.2   882.6
GR2114.4   887.3  2114.9     889  2115.5   892.8  2115.3   893.8  2116.1   895.3
GR2115.7     897  2117.2   898.5    2117   900.2  2129.5   946.7  2133.5   955.1
GR  2138   979.7  2139.9   988.2  2140.7  1001.8  2141.1  1017.1  2139.8  1025.4
GR2138.9  1026.4  2138.4  1056.5  2138.9  1057.8    2139  1061.2  2136.6  1073.9
HD56.626      30   679.0   900.2
```

CROSS SECTION #RM156.686

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.686      78   317.1     724   314.9   314.9   314.9
GR2135.3       0  2137.2    50.2  2137.3    72.4    2137    73.1  2137.8    80.1
GR2138.5     140  2138.7   150.7    2140   167.9  2139.9   178.3  2139.3   188.1
GR2141.6   195.6  2141.6   200.8  2138.9   205.4  2138.3   207.5  2138.5     213
GR2138.1   216.3  2141.5   229.3  2142.4   238.9  2140.4   250.5  2141.8   301.7
GR2141.1   307.5  2142.9   317.1  2141.7   325.4  2141.6   331.7  2140.3   336.5
GR2132.5   350.3  2131.1   365.5  2121.6   393.4  2121.5   395.1  2120.9   397.7
GR2118.7   404.7  2116.2   414.3  2116.1   415.9  2114.3   425.4  2113.9   429.6
GR2114.1     435  2113.9   436.6  2114.2   438.3    2114   452.6  2113.8   454.2
GR2114.1   462.9  2114.1     474    2114   478.8    2114   499.5  2113.9   502.8
GR2113.9   513.9    2114   515.4  2113.6   561.6  2114.7   572.7  2114.3   573.4
GR2114.6   605.4    2115   610.9  2115.8   614.1  2116.4     615    2118   619.8
GR2119.2   621.3  2120.3   623.7  2121.2   624.6  2123.5   630.7  2128.8   672.5
GR2129.9   690.8  2130.5   693.2    2137   706.5  2141.4     724  2141.6   729.8
GR2140.2   743.1    2138   749.6  2139.3   758.6  2136.8   771.7    2137   772.5
GR2136.6   807.9  2137.5   809.6  2136.8   820.3  2136.5   830.1  2136.5   959.3
GR2136.6     970  2136.6  1024.6    2160  1197.2
HD56.686      30   414.3   615.0
```

CROSS SECTION #RM156.750

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.750      79   437.2   811.2   338.1   338.1   338.1
GR2140.7   300.4  2141.3   306.8  2141.6   314.6  2141.1   324.9  2141.4   329.7
GR2141.5   349.1    2140     351  2141.4   353.4  2142.4   377.4  2142.6   378.1
GR2140.9   390.3  2140.4   390.5  2140.6   398.8    2141   404.3  2141.6   409.5
GR2141.5   437.2  2139.4   450.5  2138.9   451.8  2134.1   457.9    2129   465.7
GR2119.2   502.6  2116.8   503.5  2118.5   504.2  2118.2     505  2116.9   505.9
GR2116.4   506.7  2117.4   507.4  2117.3   508.3  2116.4     510  2116.2   511.5
GR  2115   514.6  2113.6   518.6  2113.1   519.4  2112.1   523.4  2111.8     524
GR2111.1   529.7    2111   531.2    2111   536.9  2110.5   552.8  2110.1   556.9
GR2110.1   565.6  2110.8   582.2  2110.3   595.8  2108.9   618.2  2108.1   646.1
GR2108.5   649.2  2108.8   653.8  2108.8   658.6    2109     666    2110   677.8
GR2109.9   679.3  2110.9   686.7  2111.3   687.3  2111.5   688.9    2113   693.7
GR2113.4   694.3  2117.8   706.5  2132.6   754.7  2132.4   755.8  2133.4     758
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GR2133.6   767.6  2134.7   783.8  2135.8   790.1  2137.1     792  2141.5   804.2
GR2141.6   811.2  2141.5   815.1  2139.1   827.8  2138.6   828.9    2138   835.4
GR2138.2   838.7  2137.9     840  2138.9   846.8  2138.6   850.7    2137   856.6
GR2136.2   860.7  2136.7   861.4  2136.9   869.5  2136.7   886.5
HD56.750      30   502.6   694.3
```

CROSS SECTION #RM156.817

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.817      80   395.8   747.4   352.9   352.9   352.9
GR2137.5   264.1    2140   286.4  2141.2   347.2    2143   356.4    2143   361.9
GR2139.5   378.7  2141.9   395.8    2141   405.9  2140.7   423.4  2140.9   425.8
GR2139.7   431.1  2139.6   437.9  2132.3   452.3  2131.3   453.2  2131.7   454.7
GR2128.8   457.4  2114.9   501.6    2115   504.2  2113.1   504.8  2113.2   507.3
GR2111.6   508.8  2111.5   510.5  2108.6     516  2108.3   517.8  2107.4   518.2
GR  2105   532.7  2105.5   535.3  2104.6   535.9  2105.3   538.6  2104.3     539
GR2105.3   541.6  2104.1   542.3  2104.7     544  2104.3   550.4  2104.8   551.9
GR2103.8   552.5  2104.5   555.2  2103.6   555.6  2104.2   558.3    2103   570.7
GR2100.4   593.1  2100.2     602  2100.4   605.3  2103.4   614.5  2103.6   622.6
GR2103.6   633.1  2104.3   643.4  2105.1   644.9  2104.8   646.7  2107.6   655.2
GR2107.2   657.9  2109.1   658.3  2108.7   660.9  2110.6   661.5  2110.2   664.2
GR  2112   664.6  2111.9   667.3    2113   667.9  2112.9   670.5  2112.7   671.4
GR2114.1   672.1  2113.5   674.7  2115.3   675.1  2114.3   677.5  2115.2   681.7
GR2127.8   714.6  2140.3   734.5  2146.5   747.4  2146.4   755.7  2147.5   789.8
GR2147.5   794.4  2149.7   794.9  2154.8   800.8  2161.8     812    2163   827.3
GR  2162     873  2159.6   879.1  2158.1   894.7  2156.2   909.6  2154.7   918.8
HD56.817      30   501.6   681.7
```

CROSS SECTION #RM156.877

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.877      68   127.2   468.2   319.5   319.5   319.5
GR2138.8       0  2138.8     1.6  2139.9     4.2  2140.3    11.3  2140.7    12.2
GR2140.4    16.2  2140.2    16.8  2143.4    30.1  2143.2    32.4  2141.2    38.6
GR2139.8    46.6    2139    48.3  2141.6    76.9  2140.6    85.6  2142.6   127.2
GR2128.4   155.2  2128.2   156.3  2129.1   165.8  2121.6   180.4  2120.8   183.6
GR2117.9   191.1  2116.4   192.9  2113.5   199.9  2113.7   200.2  2112.9   202.2
GR2111.7   203.3    2111   205.3  2109.6   213.5  2108.2   218.8  2107.6   222.1
GR2106.5   233.4  2105.9   240.5    2106     249  2106.7   251.2  2106.2   262.7
GR2105.8   265.4  2106.1   265.8  2105.1   278.9  2104.8   282.2  2104.4   289.3
GR2103.2   300.8  2102.8   308.1  2102.8   310.3  2105.6   318.3  2105.5   321.6
GR2105.4     333  2106.3   345.6  2106.2   354.7    2106   379.8  2106.5   382.8
GR2110.3   394.1  2112.1   400.6  2113.3   403.7  2115.9   406.8  2116.7   407.7
GR  2118   409.9  2119.8   411.9  2131.8   429.6  2133.8   435.4  2134.1   438.7
GR2133.8   460.7  2135.6   468.2  2134.2   543.8  2135.2   552.9  2134.9   595.7
GR2134.4   601.6  2134.9   610.1  2135.7   744.6
HD56.877      30   203.3   403.7
```

CROSS SECTION #RM156.938

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X156.938      79   290.5   635.7   317.9   317.9   317.9
GR2141.7   234.4  2141.2   235.2  2140.8   248.7  2141.8   249.2  2141.6   250.4
GR2141.9   250.9  2141.9   263.6  2142.3   267.7  2142.1   269.1  2142.6   271.2
GR2142.3   271.3  2142.1     284  2142.4   290.5  2136.4   302.8  2135.8   303.5
GR2135.1   303.7  2129.8   312.6  2128.7   319.3    2120   348.4  2119.7   350.1
GR  2119   351.3  2119.1   351.6  2115.7   358.8  2115.8     359  2115.1   360.3
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GR2114.5   360.4  2113.9   363.3  2112.5   364.8  2112.1   367.7  2112.2   374.9
GR2112.9   385.2  2112.9   404.3  2112.5   405.9  2112.9   407.3  2112.6   420.5
GR2113.1   421.8  2112.4     422    2113   423.4  2113.1   426.3  2112.4   443.9
GR2111.8   449.9  2111.6   464.5    2111   477.8  2110.8   492.5  2110.2   501.1
GR  2110   505.7  2109.4   531.9  2109.2   533.3  2109.6   539.4  2111.7   546.6
GR2111.9   546.8  2113.1   549.7  2113.3   551.1  2128.2   604.2  2127.6   608.4
GR2129.9   613.4  2131.5   614.4  2133.4   620.7  2133.2   624.9  2134.4   635.7
GR2133.7   637.4    2134   637.9  2134.6   647.6  2133.9   649.7  2134.6   650.4
GR  2134   651.7    2134   652.3  2134.7     654  2133.8   655.9  2134.2   660.5
GR2133.9   662.4    2135   675.9  2134.7   679.5  2135.2   683.9  2135.3   688.4
GR2134.6   707.2  2134.8   710.1  2134.7   715.8  2134.4   719.9
HD56.938      30   358.8   551.1
```

CROSS SECTION #RM157.004

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.004      80   241.5   561.6   352.5   352.5   352.5
GR2140.9   181.9    2141   188.3  2141.7   194.7  2141.4   200.9  2141.7   201.4
GR2142.4   209.4  2141.2   241.5  2129.7   262.4  2130.8   262.6  2131.2   267.6
GR2117.1   300.8  2116.1     305  2115.2     306  2115.8   306.5  2115.3   308.2
GR2113.9   317.8  2113.9     323  2114.2   335.9  2114.9   347.6  2115.6   366.7
GR2115.5     386  2115.7   387.1  2115.4   387.5  2115.9     390  2115.4   390.3
GR  2116   391.6  2115.3     392    2116   397.3    2116   410.6  2116.2   412.3
GR2116.6   418.6  2115.4   427.1  2114.5   444.5  2114.3     450  2114.2   460.7
GR2113.7   481.6  2112.5   482.8  2113.7   483.3    2111   483.8  2112.6   484.3
GR2111.2   485.6  2112.7   485.9  2111.4   487.3  2111.2   494.6  2112.2   495.1
GR  2111   495.8  2111.9   496.1  2111.5   497.4  2112.3   497.7  2111.5   500.2
GR2112.2   500.6  2111.9   501.9  2112.7   502.1    2112   503.1  2128.6   555.5
GR2128.1   556.1  2129.6   561.6    2129   563.6  2129.9   585.7  2129.8   587.7
GR  2129   588.4  2129.4   589.7  2129.9   590.4    2129   591.2  2128.8   592.2
GR  2129   596.2  2129.7   596.4    2129     597  2128.9   597.4  2129.6   598.5
GR  2129   604.7  2129.4   606.2  2129.3   609.3  2129.9   619.5  2129.2     622
GR  2130   625.5  2129.6   626.6  2130.2   627.8  2130.2   636.1  2130.5   637.1
HD57.004      30   300.8   503.1
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CROSS SECTION #RM157.067

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.067      70   124.2   413.3   334.4   334.4   334.4
GR2143.3       0  2142.6     4.1  2142.5    16.3  2143.1    16.6  2142.5    19.3
GR2142.4    20.8  2143.7    30.2  2142.2    40.5  2140.9    44.2  2141.2    49.8
GR  2141    56.4  2142.8    71.6  2143.6      82  2143.7    90.1  2145.3    94.5
GR2139.4   104.5  2139.3   124.2  2123.2   138.5    2122   142.8  2122.3   142.9
GR2120.9   147.1  2121.1   147.3  2119.9   151.7  2117.2   157.5  2117.4   157.5
GR2116.5   164.9  2115.9   166.6  2115.1   170.8  2114.8   175.1  2114.5   200.1
GR2114.4   214.9  2114.9   225.2  2114.9   232.5  2115.1   248.4  2115.5   254.3
GR2115.8   263.1  2115.8   264.7  2115.9     266  2115.9   267.5  2116.2   270.6
GR2116.2   276.3    2115   298.5    2115   301.4  2114.9   302.9  2114.7   304.4
GR2114.9   305.8  2114.9   308.8  2114.2   314.6    2114   317.6  2113.8   326.3
GR2113.7   327.6  2113.7   333.7  2113.3   339.6  2113.4   342.5  2114.2   346.8
GR2114.5   347.1  2116.5   352.7    2117   352.9  2116.8   354.2  2117.3   354.2
GR  2129   389.6  2129.8   390.3  2129.6   390.8    2131   394.5  2130.9   397.7
GR2134.2   401.6  2134.3   404.2  2137.2   409.9  2137.4   413.3  2136.8     471
HD57.067      30   151.7   354.2
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CROSS SECTION #RM157.127

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NC .0291   .0291   .0331
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NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.127      80   243.5   549.6   323.3   323.3   323.3
GR2142.4   164.4  2143.5   180.4    2143   185.5  2141.6   193.4  2142.9   212.1
GR2139.1   243.5  2136.8   268.7  2120.4     281  2117.7   284.5    2117   285.8
GR  2117   286.3  2115.7   290.2  2115.8   290.9  2115.4   291.9  2114.7     298
GR2114.2   299.2  2114.4   299.8  2113.9   300.3  2113.3   304.8    2114   321.1
GR  2114   325.6  2114.3   331.2  2114.9   334.7  2115.2   340.3  2114.8   340.8
GR2115.3   343.1  2114.9   343.6  2115.2   344.9  2114.6   345.4    2115   346.4
GR2114.8   349.2  2114.8   362.3    2115   362.9  2115.3   372.8    2115     374
GR2115.6   374.8  2115.3   375.6  2115.6   376.3  2115.2   376.9    2116   377.5
GR2116.1   378.3  2116.1   385.9  2115.9   386.4  2115.9   388.7  2115.6     391
GR2115.4   397.6  2114.6   406.7  2114.8   407.8  2114.5   408.3  2113.7   427.5
GR2113.8   428.5  2113.6   429.2  2113.6   440.4  2113.4     441  2113.6   441.5
GR2113.4   442.2  2113.5   443.2  2113.2   443.7  2113.3   444.9  2112.9   445.5
GR2113.4   446.2    2113   446.5    2113   455.1  2112.9   455.6  2113.2   461.2
GR2114.9   471.3  2116.1   480.5  2129.9   522.8    2129   523.8  2130.1   524.5
GR  2133   529.6  2136.4   536.7  2137.9   544.5  2138.3   549.6  2138.3     558
GR2138.1   563.3  2138.3   563.5  2138.5   588.4  2137.8   627.7    2137   644.9
HD57.127      30   284.5   480.5

   CROSS SECTION #RM157.188
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.188      80   268.5   547.4   329.6   329.6   329.6
GR2141.1     176  2141.6   178.5  2141.6   182.4  2142.9   196.5  2142.9     199
GR2141.4   212.2  2141.2   233.8  2141.5   237.9  2141.9   238.8  2141.5   268.5
GR2129.9   270.3  2120.4   287.4  2119.8   289.2  2118.4   292.1    2116   296.6
GR2115.8   297.4  2113.4   299.4  2112.9   300.2  2112.5   301.7  2112.5   305.6
GR2113.2     313  2113.7   323.7  2113.7   326.5  2113.5   328.3  2113.3   335.5
GR2112.9   339.4  2112.9   343.9  2113.3   351.3  2113.5   352.3  2113.2   355.7
GR2113.3   374.8    2113   375.9  2115.1   377.7  2114.8   379.2  2114.9   382.7
GR2115.2   383.3  2114.6   395.3  2114.4   395.8  2114.1     403  2114.1   408.6
GR2113.8   409.1  2113.9   413.2  2113.3   418.8  2113.4   420.3    2113   421.4
GR2113.3   422.2  2113.1   423.7  2112.6   435.7  2112.8   436.9  2113.7   446.9
GR2113.5   452.6  2113.5   457.7  2113.8     462  2115.4   470.5  2114.7     471
GR2116.6   471.5  2115.1   472.2  2115.7   473.2  2115.1   473.8  2115.3   475.1
GR2115.8   476.1  2115.3   476.6  2115.9   480.4  2115.6   481.4  2116.5     485
GR2116.2   485.8  2136.2   529.2  2136.8     530  2139.1   543.9  2139.3   547.4
GR2139.1     554  2139.2   554.3  2138.6   565.5  2138.8   567.6  2138.8   591.3
GR2138.9   594.4  2138.5   598.5  2138.8     599  2138.3   605.4  2138.1   622.8
HD57.188      30   296.8   485.8

   CROSS SECTION #RM157.249
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.249      80   202.9   530.9   325.6   325.6   325.6
GR2137.7   162.6    2138   163.7  2137.9   166.5  2138.6     178    2143   191.6
GR2143.1   202.9  2134.2   229.8  2134.8   230.6    2132   234.3  2120.2   262.1
GR2119.4   266.2  2118.9   267.7  2116.3   268.5  2117.1   270.5  2115.7   271.3
GR  2116   272.3  2115.4   273.1  2115.7   275.1    2115   275.9    2115   276.7
GR2114.3   277.7  2115.3     278  2114.5   278.7  2112.2     287  2113.8   314.1
GR2114.1   332.4  2114.6   352.3  2114.9   361.3  2115.3   363.6  2114.5   370.5
GR2114.6   370.8  2114.4   375.4  2114.3   388.9  2113.7   398.9  2113.5   400.7
GR2114.1   401.2  2113.6   401.7  2113.7   404.1  2113.4   405.2  2114.6   406.2
GR2113.7   406.9  2114.6     408  2113.8   408.7  2115.6     409  2114.6   409.7
GR2115.8   410.7  2114.6   411.5    2116   412.5  2115.8   414.3  2116.5   415.9
GR2116.4   418.7  2116.6   419.7  2115.2   420.5  2116.6   420.8  2114.9   426.1
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GR2115.8   427.1  2114.3   427.7  2115.5   428.1  2115.6   429.9  2114.7   430.5
GR2115.5   431.5  2114.3   432.3  2114.7   432.6  2114.7   433.3    2113   438.9
GR2112.7   441.8    2113     449  2113.4   452.3    2114   459.7  2115.4   468.7
GR2134.1   511.1  2132.6     512    2136   518.7  2137.6   523.2    2139   530.9
GR2139.1   546.3  2138.8   570.2  2138.8   609.1  2138.9   610.4  2138.3   640.6
HD57.249      30   268.5   468.7
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CROSS SECTION #RM157.316

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.316      71   316.5   616.6   358.5   358.5   358.5
GR2161.8      93  2159.4   101.7  2151.1   111.3  2137.1   156.7  2137.9   161.4
GR2140.6   231.8    2142     233  2139.7   251.9  2138.9   253.1  2139.7   259.3
GR2139.5   259.3  2140.8     262  2140.5   262.7  2140.9     263  2142.3   269.4
GR2143.2   281.6  2142.6   288.6  2139.1   294.8  2141.4   316.5  2140.2   320.7
GR2123.4   332.3  2121.9   336.8  2120.5   339.3  2117.7   339.8  2116.8   346.7
GR2113.8   357.2  2113.9   367.8  2113.9   368.9  2114.2   373.5  2114.6     385
GR2114.8   385.2  2115.8   409.7  2116.3   417.4  2116.3   423.3  2116.1   432.2
GR2115.2   448.3  2114.6   479.3    2115   498.4  2116.6   508.1  2116.6   509.8
GR  2117   510.2  2116.4   512.7    2117     513  2116.7   514.2  2116.5   524.6
GR2117.4   537.8  2117.4   542.5  2117.6   549.7  2119.4   557.1  2128.6   583.5
GR2128.7   589.5  2130.4     595    2134     599  2139.5   616.6  2139.1   617.8
GR2139.2   631.9  2139.6   649.8  2139.2   659.2  2139.2   666.6  2139.4   676.5
GR  2139   691.2  2139.1   691.4  2138.8   715.7  2137.8   747.4  2137.5   748.7
GR2135.5     793  2134.9   796.7  2134.8   820.3  2135.1   839.5  2135.4   892.1
GR2135.5   895.3
HD57.316      30   339.8   549.7
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CROSS SECTION #RM157.389

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.389      81   272.4   611.1     391     391     391
GR2143.8   250.1  2143.8   250.9  2143.3   252.9  2143.3     255  2142.5   265.7
GR2141.1   272.42141.076   272.5    2140     277    2120   321.3  2118.4   322.7
GR2119.4   322.8  2117.8   324.2  2117.5   325.6  2116.4   328.5  2116.7   328.6
GR2116.1     330  2115.4   340.2  2115.2   341.8  2114.5   343.1  2114.8   343.3
GR2113.7   344.7  2113.5   347.7  2113.2   349.1  2112.5   350.6    2112   353.5
GR2111.5   354.9  2111.3   357.8  2111.4   360.9  2112.2   369.7  2112.4   371.1
GR2113.8   391.7  2113.9   401.9  2114.1   403.3  2113.9   403.5  2114.1   412.1
GR2113.5     421  2113.5   429.7  2113.6   429.9  2113.6   441.5  2113.4   441.8
GR2113.4   453.4  2113.8   469.4  2113.6   481.2  2113.8   484.3  2114.2   485.5
GR  2114   485.6  2114.3   487.2  2114.9   488.5  2114.6   491.4    2115   492.8
GR2114.8     493  2114.8   498.9    2116   510.7    2116   513.6  2115.8   516.5
GR2115.6   522.1  2115.9   525.2  2116.3   526.6  2130.9   568.5  2132.1   571.4
GR2134.3   580.4  2134.9     581    2136   583.5  2135.9   583.6  2139.9   603.6
GR2139.9   611.1  2140.1   611.6  2140.1   615.2  2140.3   617.2  2139.9   626.9
GR  2140   628.3    2140     646  2139.8   647.2  2139.9   650.3  2139.5   666.5
GR2139.1   671.6  2139.3   673.4  2139.4   673.5  2139.1   691.9  2139.2   693.6
GR2138.9   695.5
HD57.389      30   328.5   526.6
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CROSS SECTION #RM157.468

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.468      80    77.4   412.6   426.4   426.4   426.4
GR2172.4       0  2157.2    47.5  2154.6    51.2  2144.5    58.7  2143.8    66.8
GR2142.6    77.4  2123.3     119  2121.6   126.3  2120.7   126.8  2121.3   127.5
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GR2120.5   128.2  2119.8   130.7  2118.8   131.2  2119.4   131.9  2117.9   132.3
GR  2118   133.7  2116.7   134.1  2117.6   134.8  2116.3   135.3  2114.9   136.7
GR2114.5   137.9    2114   138.6  2114.2   139.2  2113.9   139.7  2113.7   145.7
GR  2114   150.1  2114.6   155.6    2115   156.1  2115.7   161.6  2115.6   164.6
GR2114.2   169.5  2113.9   173.2  2114.1   185.4  2114.8   198.1  2114.8   202.5
GR2115.1   217.5  2115.1   220.7  2114.7   232.2  2114.1   240.8    2114   248.1
GR2114.3   248.8  2113.8     250  2113.8   251.4  2113.6   251.8  2113.4   265.9
GR  2114   275.6  2113.6   276.1    2114   276.8  2113.6   280.5    2114   280.9
GR2113.9   282.3  2114.4   285.3    2115   286.7  2115.6   287.1  2115.1   287.6
GR2115.5   288.3  2115.5   294.5  2116.3   305.6  2116.2   315.3  2116.3   323.1
GR2115.6   325.4  2115.6     328  2116.1   332.3  2116.7   333.5  2116.1     334
GR2130.3     364  2134.7   382.2  2135.2   382.9  2134.7   384.5  2135.5   385.9
GR2136.3   390.2  2136.6   390.8  2136.6     394  2139.5   402.9  2140.1   407.1
GR2140.2   412.6    2140   415.5  2139.9   440.7    2140   444.4  2139.8   495.9
HD57.468      30   132.3   334.0

   CROSS SECTION #RM157.534
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.534      80   349.3   730.5   352.7   352.7   352.7
GR2143.6   337.8  2143.5   349.3  2142.2   361.2  2120.5   397.3  2120.2   398.6
GR2119.8   399.5  2119.2   400.4  2119.4   400.6  2118.9   401.7    2116     410
GR2114.6   414.3  2111.6   421.4  2111.3   423.5  2111.3   427.7  2111.8   432.7
GR2113.1   439.8  2113.4     441  2113.9   445.2  2113.8   446.1  2114.4   456.6
GR2114.6   457.5  2114.3   484.6  2114.3   491.8  2114.2   492.9  2114.2   508.6
GR2114.1   509.5  2114.3   510.6    2114   512.6  2113.6   523.1  2113.3     524
GR  2114   525.1  2113.7   526.3  2113.3   527.2  2114.1   528.3  2113.4   530.3
GR2114.1   531.4  2113.5   533.4    2113   539.7  2112.8   540.6    2113   544.8
GR2112.9   545.8  2113.2     546  2112.8   546.9  2112.8     548  2112.6   548.9
GR2112.8   549.1  2112.4     550  2112.5     552  2113.2   555.2  2113.6   563.5
GR2114.2   569.7  2114.4     576  2114.6   576.9  2114.4   577.1  2114.6   578.2
GR2114.8   584.1  2114.9   585.4  2116.4   594.6  2117.5   599.7    2135     653
GR2136.8   656.5  2139.1   664.9  2139.1   672.8  2138.8   675.7    2139   678.4
GR2139.2   678.6  2139.6   683.3  2139.7   688.8  2140.8   708.6    2141   717.5
GR2140.9   722.5  2141.1   730.5  2140.1   757.1    2140   763.4  2139.4   775.7
GR2139.2   776.4  2139.3   778.2  2138.2   789.7  2137.8   795.9  2137.6   801.4
HD57.534      30   401.7   599.7

   CROSS SECTION #RM157.605
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.605      80     298   674.4   383.9   383.9   383.9
GR2143.1     298  2141.3   318.6  2135.8   327.9  2135.2   339.3  2135.4   343.1
GR2120.8   361.8  2120.5   362.9  2119.8     364  2118.9   365.1  2118.6   366.2
GR2117.9   367.1  2116.8   369.1  2114.4   374.4  2113.8   375.5    2114   376.6
GR2112.2   379.5  2112.6   380.6    2112   382.6  2112.3   390.9  2112.2   393.1
GR2112.6   393.3  2112.7     396  2112.9   396.4  2113.4   401.5  2113.3   407.7
GR2112.6   410.6  2113.3   410.9  2112.8   413.7  2113.5   414.9  2113.3     416
GR2113.6     418    2113   421.1  2113.4   422.2  2113.1   424.2  2113.6   424.4
GR2113.2   427.3  2113.7   427.5  2113.5   428.4  2113.2   431.3  2113.5   431.5
GR2113.2   434.4  2113.5   434.6  2113.4   435.7  2113.4   440.6  2113.6   445.9
GR2113.4   447.9  2113.4   452.2    2113   468.6  2112.8     470  2112.6   475.1
GR2112.7   475.9  2112.8   485.5  2112.5   489.5  2112.2   489.7  2112.2   492.6
GR2111.9   492.8  2111.9   500.2  2112.2   505.1  2112.8   511.5  2113.6   516.6
GR  2114   517.7    2117     531  2117.8   541.5  2127.8     608  2129.6   608.4
GR  2134   615.9  2134.4   617.5  2138.4   627.1  2138.4   629.9  2139.5   637.5
GR2139.2     641  2140.9   674.4  2141.1   693.9  2140.1   724.7  2139.9     733
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GR2138.8   748.1  2137.9   761.9  2137.9   765.5  2137.5   767.2  2137.7   767.4
HD57.605      30   367.1   541.5
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CROSS SECTION #RM157.669

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.669      79   174.2   525.8   341.8   341.8   341.8
GR2225.3       0  2215.8     5.8  2215.6     7.8  2212.1     8.8  2211.3    28.3
GR2199.6    41.5  2185.9    61.9  2180.3      72  2173.9    80.3  2171.7    87.3
GR2141.1   146.7  2141.9   150.5  2143.8   167.6  2145.1   174.2  2144.7   177.7
GR2141.4   190.7    2140   192.4  2137.2   200.1  2137.6   200.2  2136.8   200.6
GR2135.1   206.8  2125.3   232.6  2123.9     238  2120.8   243.1  2120.1   243.1
GR2113.7   257.8  2111.4     265  2110.9   268.1  2110.4   276.3  2109.7   284.6
GR  2110   284.8  2109.7     292  2108.9   301.3  2109.5   301.3  2109.1   303.4
GR2108.3   316.8    2108   317.9  2108.3   322.1  2106.7   339.5  2106.4   340.6
GR2105.6   348.9  2105.9   350.9  2105.5   353.1  2105.8   355.2  2105.8   363.4
GR  2106   363.6  2106.4   375.9  2107.5   384.4  2110.4   391.5    2111   391.5
GR  2111   392.6  2111.7   393.5  2115.1     402    2115   402.9  2115.8     406
GR  2118   412.2  2120.3   421.7  2120.8   422.5  2120.6   422.8  2128.2   460.6
GR2128.1   462.6  2132.1   489.3  2133.8   497.1  2134.6   498.2  2138.1   513.5
GR2141.7   525.8  2142.2   552.4  2141.6   570.5  2141.2   586.5  2140.6   591.2
GR2140.8   592.6  2140.4   598.3  2139.6   602.7  2136.4   641.2  2135.2   671.8
GR2135.4   678.3  2134.5     685  2134.3   690.3    2134   711.3
HD57.669      30   257.8   402.9
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CROSS SECTION #RM157.756

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NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.756      80   253.6   589.2   467.6   467.6   467.6
GR2146.3   217.2  2146.7   217.9  2146.1   226.8  2145.9   232.1  2146.8   246.1
GR2146.1   251.1  2146.6   251.6  2147.1   253.6  2145.2   264.7  2143.2   266.2
GR2131.9     283  2119.6   308.8  2119.2   310.2  2119.1   311.6  2118.8   311.7
GR2117.1   317.4  2116.4     319  2116.2   320.5  2112.7   326.4  2110.7   332.2
GR2110.5   333.6  2109.9   335.1  2110.4   335.3  2109.6   336.5  2109.2   338.2
GR2108.7   339.6  2104.1   349.9  2103.1   354.2    2102   367.6    2102   371.9
GR2101.8   374.7    2102     375  2101.6   377.7  2101.4   380.5  2101.6   380.7
GR2101.6   386.5  2102.5   392.4  2102.6   393.9  2103.2   395.3  2103.8   399.6
GR2103.8   401.3  2104.7   410.1  2104.9     413  2105.6   417.3  2107.2   424.5
GR2109.2   430.5  2109.8   431.9  2111.2   440.7  2111.1   440.8  2113.5   449.4
GR2113.4   449.6  2115.3   456.8  2130.1   494.3  2134.7   502.5    2136   511.3
GR2137.7     543  2137.6   543.6    2138     549  2137.8   549.3    2138   553.3
GR2138.9     562  2139.6     566  2141.2   578.2  2140.9   582.5  2141.2   589.2
GR  2141   604.3  2140.8   604.5  2140.9   613.9  2140.6   617.2  2140.5   626.3
GR2140.2   629.9  2140.2   632.2  2139.4   637.7  2139.9   638.4    2139   645.4
GR2138.7   651.3  2138.2   652.8  2138.3   655.6  2137.8   657.6  2137.9   662.7
HD57.756      30   320.5   449.4
```

CROSS SECTION #RM157.840

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.840      70   199.6   499.2   449.5   449.5   449.5
GR2175.5   126.3  2175.7   127.7  2171.4   133.6  2155.5   168.9  2156.7   169.3
GR2151.8   175.3  2146.9   178.6  2145.5     181  2145.1   191.6    2143   199.6
GR2131.3   219.8  2131.6   221.5  2123.2   229.1  2122.6   232.4  2119.9   239.7
GR2117.9   242.8  2117.6   243.7  2109.8   249.9  2108.3   251.8  2103.7   260.3
GR2101.2   269.6  2100.4   274.9  2100.4     280  2100.7   280.9  2102.6   295.5
GR2104.5   306.8    2106   319.4  2106.2     334  2107.4   340.2  2108.1   342.2
```

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GR2114.2   354.6  2115.7   371.4  2117.1   372.3  2116.1   372.5  2117.8   373.4
GR2119.4   379.6  2119.9   380.7  2119.9   382.7    2121   382.7  2121.4   386.9
GR2121.9   387.1  2122.6   389.8  2123.1   392.9  2130.7     404  2133.1   414.8
GR2134.5   426.1  2139.1   450.7  2141.1   482.9  2141.4   499.2  2141.4     512
GR2141.7   513.6  2141.5   523.7  2141.9   527.5  2141.4   527.9  2141.3   537.9
GR2140.7   540.4  2139.9   556.5  2139.3   559.4  2139.5   562.3  2137.7   567.6
GR2136.8   580.7  2137.6     588  2136.6   610.7    2137     612  2136.7   618.7
GR2136.1   621.2  2136.7     624  2135.9   625.3  2136.6   629.5  2135.7   629.8
HD57.840      30   242.8   371.4
```

CROSS SECTION #RM157.959

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X157.959      80   183.8   505.6   638.2   638.2   638.2
GR2145.9   183.8    2145   192.1  2145.5   192.2  2144.9   193.9  2142.6   206.8
GR  2135   216.7  2116.4   245.6  2115.5   246.2  2114.6   249.1  2114.1   249.3
GR2113.9   249.5  2113.1   252.8  2110.4   265.5  2110.4   265.9  2107.1     279
GR2106.5   281.9    2104   291.8  2102.2   298.1  2101.3   301.8  2098.3   311.5
GR2098.3   311.7  2098.9   312.1    2098   314.7  2098.2   315.1  2098.2   318.2
GR2098.4   318.4  2098.6   321.3  2100.3     325  2100.7   331.2    2101   331.6
GR2100.9   334.4  2101.3   334.8  2101.1   337.7  2101.6   338.1  2101.4     341
GR2102.5   341.4  2102.4   344.3  2102.8   344.5  2104.5   347.8  2104.4     348
GR2106.1   350.8  2106.7   351.3    2107   353.9  2107.7   354.5  2107.9   357.2
GR2108.3   357.6  2108.8   360.5  2109.2   360.9  2110.3   364.2  2114.7   373.8
GR2114.6   374.4  2115.8   377.7  2116.3   380.4  2116.8     381    2117   383.7
GR2117.6   384.3  2117.7     387    2118   387.4  2118.3   390.7  2129.9   423.5
GR2130.3   426.8  2133.3     430  2137.6   444.9  2138.4   456.3  2138.3   469.5
GR2141.5   480.9  2141.7   494.1  2142.9   505.6  2142.6     522    2143   525.1
GR2142.9   533.5  2142.5   536.7    2143   538.4  2142.4   541.7  2142.9   544.9
GR2142.2   556.4  2142.6   559.7  2142.2     563  2142.3   572.8  2140.9   589.3
HD57.959      30   252.8   373.8
```

CROSS SECTION #RM158.056

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.056      60   185.7   511.6   529.7   529.7   529.7
GR2175.1   114.3  2171.4   123.8  2159.5   143.8  2150.7   154.7  2151.8   155.2
GR2146.3   159.8    2145     165  2145.4   165.3  2144.6   177.2  2143.8   185.7
GR2142.8   188.2  2136.9   196.6  2134.4   198.5    2132   201.4  2129.7   208.6
GR2121.4   220.3  2119.5   227.5  2115.6   238.9  2113.9   240.2    2110   248.7
GR2108.6     254  2108.1   256.7  2107.8   262.4  2106.5     273  2106.9   276.8
GR2107.5   283.5  2107.6   286.8  2109.3   299.8  2109.9   301.2  2110.8   306.9
GR2110.9   309.6    2112   321.3  2113.7   329.4  2113.7   330.7  2115.5   340.5
GR2114.9   359.6  2115.3   371.3  2116.1   377.3    2117     389  2117.1   393.6
GR2117.9   395.1  2122.9   414.1  2122.8   414.6  2124.6   420.4    2126   430.5
GR2126.5   436.2  2126.5   438.9  2129.3   444.9  2133.7   451.1    2135   452.5
GR2138.6   461.3  2138.6   465.9  2138.1     468  2141.7   493.5  2141.5   502.9
GR2143.3   511.6  2142.5   512.8  2141.5   590.6  2140.8     603  2140.7   630.8
HD58.056      30   227.5   395.1
```

CROSS SECTION #RM158.162

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.162      80   211.2   520.5     577     577     577
GR2139.4   160.1  2141.5     170  2142.9   185.9  2142.9   211.2  2142.6   212.6
GR2116.8   270.1  2115.8   275.1  2116.3   275.3  2114.4   276.9  2115.4   277.4
GR2113.9   279.2  2114.8     280  2111.9   281.4  2112.8   282.2  2111.6   283.9
```

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GR2112.4   284.8    2111   286.2  2111.7   286.8  2110.7   288.8  2111.4   289.3
GR2110.1   290.8  2110.8   291.4  2109.8   293.3  2110.3   293.8  2109.2   295.4
GR2109.7   295.9  2107.9   302.5  2108.2     303  2107.3   307.3    2107   314.4
GR  2107   326.3  2107.9   337.3  2106.8   337.9  2107.9     340  2107.3   340.2
GR2108.5   341.9  2107.3   342.5    2109   344.5  2107.6     345    2110   346.7
GR2108.4   347.3  2110.8     349    2110   349.6  2111.6   351.2  2110.8   351.8
GR2111.8   353.6    2111   354.5  2111.8   355.8  2111.4   356.1  2110.1   365.2
GR2110.9   377.2  2111.3   377.4  2110.7   379.4  2111.6     380  2110.7   381.5
GR2111.1   381.7  2112.5   388.5  2112.9   389.1  2113.1   393.1  2113.4   393.9
GR  2113   395.4  2113.3   395.6  2113.8   402.7  2114.6   407.3  2115.7   414.9
GR2116.9   428.1  2117.5   430.2  2117.5   431.1    2120   435.6  2130.2   471.9
GR2130.4     475  2136.7   484.8  2137.1   490.5  2140.6   505.5  2140.3   510.5
GR2141.1   519.8  2141.7   520.5  2140.8   549.3  2140.9   552.5  2140.3   554.3
HD58.162      30   270.1   428.1
```

CROSS SECTION #RM158.259

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.259      73   147.9   525.8   532.9   532.9   532.9
GR2182.6      66    2182    71.7  2150.2   123.1  2143.9   132.8  2141.1   135.4
GR  2142   147.9  2140.8   158.5  2138.6   167.2  2118.1   200.9  2113.2   213.6
GR2111.7   214.3  2111.7   216.8  2110.7   217.1  2104.5   226.7  2100.8   236.7
GR2096.5   250.4  2091.7   270.2  2088.6   296.1  2088.4   312.5  2089.2   325.5
GR2091.8   348.6  2093.1   349.2  2091.9   351.7  2092.4   352.1  2092.4   358.2
GR2093.6   371.9  2094.4   374.8  2098.6   401.6  2101.2   407.8  2100.6   408.2
GR2103.9   410.7  2102.4   411.2    2102   411.6  2105.4   414.1  2103.9   414.5
GR2107.1   417.5    2105   418.2  2108.4   420.7  2106.5   421.5    2109   424.5
GR2107.2   424.9  2113.8   430.7  2111.9   431.1  2115.1   434.2  2114.3   434.4
GR2113.3   434.6  2119.5   440.5  2118.1   440.7  2116.9   440.9  2115.8   441.1
GR2120.4   443.9  2116.8   444.6    2122   447.1  2117.9   447.9  2122.7   450.6
GR2120.4   451.1  2123.2   453.5  2122.8   454.1  2120.7   454.4  2124.4   457.3
GR2125.4   460.3  2127.3   463.5  2124.8   463.9  2125.9   464.2  2128.2   474.8
GR2128.4   484.6  2131.4   492.8  2130.6   494.3  2132.7   497.1  2134.9     502
GR2137.6   503.2  2143.4   525.8  2140.2   638.4
HD58.259      30   226.7   424.9
```

CROSS SECTION #RM158.451

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.451      80   152.8   425.5  1049.9  1049.9  1049.9
GR2136.3       0  2135.8    24.8  2136.3   106.8  2136.1   112.2  2135.3   119.6
GR2135.4   126.3  2135.8   127.6  2135.4     138  2135.7   138.9  2135.5   140.1
GR2135.8   152.8  2135.5   160.2    2133   166.1  2118.5   195.8  2117.5   196.2
GR2117.5     199  2116.3   199.2  2115.6   199.4  2115.4   202.2  2113.8   202.7
GR2111.1   212.1  2110.6   212.5  2110.1   215.6  2109.7   215.8  2107.8   222.1
GR2107.5   222.5  2106.1   228.3  2106.2   228.7  2105.3   241.8  2105.5   242.2
GR2104.9   248.4    2105   248.6  2104.8   255.1  2104.5   258.1  2104.7   258.2
GR2104.3   264.7  2104.5   264.9  2104.2   268.2  2104.6   281.6    2105   284.4
GR2105.1   287.4  2105.4     288  2105.1   290.7  2105.5   291.2  2106.1   297.6
GR2106.3     298  2107.5   304.2  2107.4   304.4  2108.4   314.4  2109.5   317.2
GR2108.9   317.4  2110.8   320.3  2110.2   320.8  2111.4   323.8  2111.3     324
GR2112.5   333.8  2112.9   346.5  2113.3   353.7  2114.2   359.9  2115.4   366.4
GR2115.3   366.6  2115.8     370  2117.7   376.8  2118.9   383.2  2119.7   386.5
GR  2121   389.6  2120.9   389.9  2122.4   392.9  2123.6   395.9  2123.5   396.1
GR2124.5   399.5  2124.4   399.7  2125.2   402.8  2125.5   406.1  2125.4   406.3
GR2132.2   418.3  2133.1   425.5  2129.4   438.4  2128.1   444.7    2128   452.1
HD58.451      30   202.7   359.9
```

CROSS SECTION #RM158.634

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.634      80    95.6   488.3  1002.5  1002.5  1002.5
GR  2137       0  2136.7     1.3  2138.7    67.9  2138.9    95.6  2133.2   126.1
GR2132.8   152.2  2133.2   157.5  2129.9   178.5  2129.8   183.4  2119.4   213.5
GR2118.4   220.1  2117.4   229.6  2116.9   246.4  2116.7   249.3  2114.6   262.7
GR2113.8   275.7  2113.7   282.4  2113.4   292.1  2111.6   321.7  2111.8     322
GR  2111   327.9  2111.4   328.4    2110   337.9  2110.3   338.5  2109.4   341.1
GR2109.7   341.7  2108.8   344.4    2109   344.7    2107   354.3  2105.3   367.7
GR2105.9   368.1    2105   370.7  2105.3   370.9  2107.5   380.7    2108   380.9
GR  2107   387.2  2107.4     397  2106.4   397.6  2106.7   400.4  2106.1   400.8
GR  2107   410.7  2108.4   413.9  2109.2   417.5  2109.5   420.1  2109.2   420.7
GR2109.8   423.3  2109.5   423.8    2111   429.8  2110.7   430.2  2112.4   436.9
GR2113.9   440.1  2113.7   440.2  2115.8   443.2  2115.6   443.7  2117.8   446.3
GR2117.6   446.8  2121.5   453.2  2124.7   456.8    2126   462.9  2129.9   468.2
GR2130.1   473.2  2134.1   488.3  2133.9   494.2  2133.3   494.3  2133.9   506.2
GR2134.8   545.6  2134.2   554.9  2134.6   555.6  2134.1   558.1  2135.2   576.1
GR2134.6   584.5    2135   586.7  2134.7   588.5  2135.2   597.7  2135.1   621.9
GR2134.5   625.6  2134.5   636.3  2134.3   636.7  2135.2   643.4  2135.1     646
HD58.634      30   262.7   440.1
```

CROSS SECTION #RM158.818

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X158.818      80     159   429.3  1003.8  1003.8  1003.8
GR2133.8       0  2134.1   121.8  2133.4   126.5  2134.3   128.2  2134.1   153.2
GR2133.7   153.8  2134.5     159  2134.7   164.1  2131.2   179.5  2121.3   213.5
GR2120.7   217.4    2116   229.6  2112.2   239.9  2111.7   240.6  2111.3   243.3
GR2110.6   243.9  2109.5   252.8  2105.6   263.5  2105.9   263.9    2104   273.2
GR2103.8   279.3  2103.3   279.7  2103.5   280.4  2102.9   282.6  2102.4   282.9
GR2102.6   283.6  2101.5   286.1  2101.7   286.9  2099.6   292.8  2099.7   293.2
GR2097.9   296.7  2096.4   302.5  2095.9   303.6  2095.2   309.3  2095.2   312.2
GR2096.3   325.4  2096.5   325.8    2097   332.6  2097.6   333.3  2097.6   335.4
GR2102.8   348.9  2103.7   349.7  2104.3   352.2  2104.9   352.9  2105.5     355
GR2105.8   355.4  2111.7   366.3  2112.2   368.6  2113.7   369.3  2113.8   369.8
GR2115.4   371.8  2117.4   372.5  2121.6   378.6  2122.5   381.6  2123.5   382.6
GR2123.5   384.7  2124.3   385.4  2124.6   385.8  2124.6     388  2125.1   389.1
GR  2125   391.5  2125.5   392.4  2125.5   392.7    2134   400.1  2135.7   403.3
GR2136.1   413.6    2137   414.9  2137.6   429.3  2137.4   431.6  2136.8   432.2
GR2135.5     452  2135.8   454.4    2136   457.4  2136.9   462.4    2138   500.5
GR2137.7   506.7  2137.9   523.4    2137   529.2  2137.7   531.9  2137.1     574
HD58.818      30   243.9   366.3
```

CROSS SECTION #RM159.002

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X159.002      80     217     587  1005.4  1005.4  1005.4
GR2135.6       0  2135.8   101.4  2135.4   157.5  2134.5   167.7  2135.4   200.3
GR2136.3     217  2134.8   256.6  2134.5   258.2  2134.2   298.3  2130.4   306.8
GR2130.9   307.8  2121.1   340.4  2118.8   345.6  2118.1   345.9  2116.6   349.6
GR  2115   350.5  2113.1   355.2  2112.2   366.4  2111.8   366.9  2111.9   373.6
GR2111.5   375.3  2113.1   376.1  2112.2   377.8  2114.2   378.8  2111.8     380
GR2113.6   380.8  2111.4   382.3  2112.9   383.5  2110.3   384.5  2110.7   384.8
GR2107.6   405.4  2108.6   410.2  2109.3   410.4  2110.2   411.1  2110.1   412.9
GR2111.1   413.1  2111.9   415.6  2112.3   426.6  2111.7   431.2  2110.3     432
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GR2108.9   438.2  2107.4   440.7  2107.5   442.9  2106.4   443.4  2105.8   447.4
GR  2103   452.9  2101.1   460.3  2101.5     462    2101   462.3  2101.8     464
GR2101.1   464.3  2101.6   474.2  2104.5   483.2    2108   492.4  2111.5   499.5
GR2111.8   501.8  2113.4   508.5  2113.9     509  2116.4   517.7  2116.9   518.2
GR2120.4   532.1  2120.8   532.3  2123.8   541.3  2129.6   549.7  2129.6   553.7
GR2131.6   562.4  2138.9   581.5  2139.2     587  2138.9   601.6  2139.2   614.3
GR2139.3   631.2  2138.5   638.1  2138.3   714.9  2138.6   720.6  2138.3   723.1
GR  2139   727.5  2138.4   735.7  2138.8     743  2138.2   763.8  2138.8   848.1
HD59.002      30   340.4   532.1
```

CROSS SECTION #RM159.175

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X159.175      80    73.8   387.6   861.4   861.4   861.4
GR2136.4       0  2135.7    26.2  2135.7    29.6  2136.2    46.1  2135.8      51
GR2135.9    60.9  2136.1    69.1  2136.1    70.9    2136    73.8  2135.5   100.3
GR2134.2   110.2  2129.4   124.9  2121.8     149  2114.6   158.8  2108.8   168.7
GR2104.5   181.6  2104.4   188.2  2104.9   191.5  2105.2   194.5  2105.3   194.8
GR2105.6     198  2105.8   198.2    2106   204.6  2105.8   204.6  2104.8   207.9
GR2104.1   211.2  2104.4   214.5  2104.9   217.6  2105.7   217.8  2106.3   221.2
GR2106.1   224.1  2106.3   227.6  2106.4   230.7  2106.3     234  2106.5   234.2
GR2106.4   237.3  2106.3   240.6  2106.3   240.8  2106.3   243.8  2106.4   244.2
GR  2107   247.5  2107.7   250.6  2107.8   250.8  2108.1     257  2107.8   260.3
GR2107.4   263.3  2107.3   266.6  2107.3     267  2107.6   270.3  2108.3   273.2
GR2111.8   283.3  2112.7   286.8  2112.8   286.8  2113.2   289.8  2113.4   289.8
GR2113.5     290  2115.1   293.1  2115.3   293.3  2115.4   293.3  2117.4   296.6
GR  2119   299.7  2118.9   299.9  2120.3     303  2120.2   303.2  2121.1   306.3
GR2122.2   309.5  2122.1   309.5  2129.7   333.2  2134.6   344.5  2134.6     348
GR2134.6   351.2  2134.5   359.5    2135     371    2135   372.8  2135.2   375.9
GR2135.5   377.5  2136.1   387.6    2136   402.2    2136   403.8  2134.3   453.1
HD59.175      30   158.8   296.6
```

CROSS SECTION #RM159.363

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X159.363      80       0   561.9   934.9   934.9   934.9
GR2137.9       0  2137.8     5.7    2138       6  2136.1    61.2  2134.1   131.9
GR2133.7     133    2134   136.9  2135.1     196  2133.6   209.1  2133.6   212.8
GR2132.6   221.1  2132.4   221.3  2132.1   233.2  2131.3   233.7  2131.7   234.5
GR2131.9   238.9  2131.7   244.8  2129.8   252.8  2121.4   302.4  2119.8   308.5
GR2118.5   311.5  2118.3   312.6  2117.8   312.8  2115.5   318.7  2114.4   324.6
GR2113.5   325.9  2114.4   326.3  2113.4   327.2  2113.8   327.6    2113   328.7
GR2113.7   329.2  2112.8   330.3  2113.2   330.5    2112   334.8  2112.4   336.3
GR2111.8   336.6  2112.8   337.6  2111.7   337.9  2111.9   343.5  2111.1   349.6
GR2109.4   358.5  2110.2   359.6  2109.3   359.8  2109.4   361.1    2109   361.6
GR2108.2   387.9  2108.9   393.5  2109.8     404  2109.9   408.1  2109.5   408.3
GR2110.2     414  2109.8   414.2  2113.3   475.7  2114.6   490.3  2115.3   500.8
GR2116.7   512.7  2117.4   516.8  2118.3   519.9  2118.9     521  2119.2   521.2
GR2129.2   543.1  2130.4   547.1  2135.4   552.9  2137.5   561.9  2137.1   563.2
GR2137.3   567.8  2136.6   575.8  2136.9   576.2  2136.5   577.3  2136.4   593.4
GR2136.5   599.7  2136.1   600.6  2136.4   613.9  2135.9   619.1  2136.3   619.9
GR2136.1   632.4  2136.1     646  2133.2   706.7  2133.4   713.5  2135.6   744.8
HD59.363      30   311.5   519.9
```

CROSS SECTION #RM159.413

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
```

```
X159.413      81    73.4   460.1   247.8   247.8   247.8
GR  2137       0  2136.3    16.2  2134.4    39.7  2134.7      55  2135.2    57.5
GR2135.2    65.5  2136.1    73.4  2134.4    97.1    2134   107.4  2133.2   112.2
GR2132.6   113.1  2132.8   118.1  2131.3   125.6  2131.4   131.3  2130.7   139.1
GR2128.6   149.7  2127.4     151  2124.3   171.1  2124.2   178.6  2123.1   191.7
GR2122.7   200.5    2122   204.8  2120.7   206.4  2120.4   207.7  2119.6   216.5
GR  2118   223.9  2117.1   225.4    2115   232.7  2113.1   253.1  2112.8   259.2
GR2112.3   260.7  2109.2   264.9  2107.4   269.2  2106.6   275.2  2105.9   276.7
GR2106.4     278  2106.1   279.8  2107.1   281.1  2107.9   283.9    2109   285.7
GR2109.4   288.5  2108.5   290.1  2108.7   291.4  2107.9   292.9  2107.5   300.4
GR2107.7   308.9  2108.3   315.1  2109.3   316.4  2108.9   328.2  2108.9   335.4
GR2109.4   343.9  2109.7   348.6  2109.9   359.1  2110.4   366.5    2113   391.5
GR2113.6     400  2114.2   404.4    2115   405.9  2115.3   407.5  2117.1   410.1
GR2118.2   410.4  2119.3   411.9  2121.1   413.2  2121.6   414.7  2122.7     416
GR2124.1   419.1  2125.3   423.7  2134.9   437.1  2135.1   441.9  2136.1   449.8
GR2136.2   460.1    2136   468.4  2134.6   480.2  2134.4   480.4  2134.8   485.9
GR2134.2   492.7  2135.2   518.6  2135.8   558.9  2135.5   573.3  2135.8   592.4
GR2135.9   615.4
HD59.413      30   225.4   410.1
```

CROSS SECTION #RM159.596

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X159.596     100   234.2    1019   913.1   913.1   913.1
GR2135.7       0  2135.9    10.2  2135.7    58.4  2134.6   105.6  2133.4   116.1
GR2135.5   171.2  2135.5   234.2    2135   262.9  2135.3   264.9  2133.9   274.1
GR  2134   281.9  2124.5   344.6  2123.1   346.6  2122.7   353.8  2123.3   363.1
GR2123.5   368.6    2125   379.5  2125.7   391.5  2126.5   419.7  2126.8   421.5
GR  2127   433.2  2126.1   471.2  2125.1   491.6  2124.4   519.1  2124.1   519.8
GR2123.1   563.6  2123.3   574.9  2122.9   575.8  2122.7   612.7  2122.1   619.8
GR2121.6     634  2123.2   670.7  2123.2   698.4  2122.8   699.2  2123.4   712.2
GR2122.8   726.8  2122.8   737.9  2122.5   738.3  2122.5   754.3  2122.2   763.8
GR2122.1   784.5  2121.5   798.7  2121.1   799.1  2121.3   803.3  2121.3   810.1
GR2120.6   822.7  2120.6   827.2  2121.9   831.5  2121.7     834  2121.3   854.8
GR2120.8   866.7  2120.2     873  2119.8   886.7  2117.7   901.2    2116   903.2
GR  2116   905.7  2113.7     908  2111.4   917.1  2111.6   919.7  2112.8   925.2
GR2111.6   931.4  2109.9   933.6  2107.7   938.3  2107.3   940.8  2105.9   942.9
GR2104.8   949.9  2104.8   957.4  2106.5   966.1    2107   966.8  2108.6   971.3
GR2108.1   971.8  2133.6  1016.2  2138.3    1019  2135.9  1041.3  2137.2  1046.2
GR2137.9  1046.5  2137.5  1049.8  2136.6  1050.7  2137.2  1058.2  2136.7  1066.9
GR2137.5  1099.2  2137.3  1106.6  2136.4  1107.2  2137.4  1112.7  2140.5  1137.3
GR2139.8  1137.9  2142.6  1159.1  2144.8  1167.3  2146.3  1176.4  2147.6  1188.8
GR2148.6    1203  2148.7  1211.8  2154.1  1247.5  2154.9  1257.5  2156.7  1270.7
GR2156.2  1273.5  2156.4  1280.2  2155.2  1299.5  2155.3  1324.6  2154.9  1325.9
HD59.596      30   344.6   971.3
```

CROSS SECTION #RM159.733

```
NC .0291   .0291   .0331
NV    24  -0.033    6440 -0.0225   22000  -0.022   25500  -0.018   41000
X159.733     100   394.7  1000.4   679.6   679.6   679.6
GR2136.8       0  2135.3   158.7  2134.9   167.9  2135.6     186  2135.7   213.2
GR2135.4   228.5  2134.5   229.6    2133   240.9  2132.2   242.1  2131.6   256.7
GR2131.7   275.5  2131.2   277.8  2134.6   315.7  2134.7   323.4  2134.6   343.3
GR2135.3   346.9  2135.2   350.2  2135.6   371.1  2134.5   384.9  2137.6   394.7
GR2132.3   397.8  2125.5   406.2  2123.6   411.6  2121.4   414.3  2119.1   416.5
GR2117.4   419.5  2113.7   427.9  2109.8   440.3  2108.7   447.7  2108.3   452.7
GR2108.4   459.2  2108.4   462.2  2108.9   468.6  2109.6   474.4  2109.6   476.7
```

```
GR2110.2   485.1  2107.7   525.7  2106.9   532.8  2106.4     540  2104.5   552.6
GR  2105     561  2105.1   564.8  2104.4   583.6    2104   584.7  2104.8   585.7
GR2103.8   585.9  2104.4   586.8  2104.1   587.9  2104.5     599  2103.5   602.4
GR2103.4   610.5  2102.8   612.8  2102.3   631.3    2102   634.7  2101.6   659.3
GR2101.8   666.8  2102.5   683.5  2102.4   686.8  2103.1     696  2103.8   700.7
GR2104.2   718.8  2105.5   726.2  2104.2   741.4  2104.4   745.3  2104.4   762.5
GR2106.8   771.6  2110.2   787.8  2112.8   794.3  2115.4   807.1  2117.6   822.5
GR  2119   839.9  2120.8   874.5  2120.8   877.1  2120.6   880.8  2120.2   883.4
GR  2120   898.1  2117.7   917.2  2115.7   925.4  2114.3   926.2  2115.4   926.2
GR2115.4   928.1  2114.8     929  2117.4   929.8  2116.6   930.8  2115.2   930.9
GR2118.1   931.7  2119.3   936.3  2137.9   975.8  2138.3  1000.4  2137.3  1004.7
GR2136.4    1012  2136.5  1014.8    2136  1035.1    2136  1043.3  2137.4  1134.6
GR2138.1  1146.8  2138.7  1181.3  2139.4  1197.4  2139.4  1200.9    2140  1228.2
HD59.733      30   427.9   936.3
```

*****End of sandbed reach & S**tart of gravelbed reach***

CROSS SECTION #RM159.821

```
NC .0321   .0321   .0332
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X159.821      64    68.1   405.1   436.7   436.7   436.7
GR2134.8       0  2134.4     5.3  2134.6    22.3  2133.8    41.7  2133.6    50.1
GR2134.6    68.1  2132.5    79.9  2132.6      85  2132.5      96  2126.4   101.3
GR2126.3   102.8  2125.9   103.5  2126.1   104.6  2125.8   105.3  2121.8   114.2
GR2121.9   116.9  2122.1   117.6  2122.1   126.5    2122   129.4    2122     140
GR2121.9   141.6  2121.9   144.1  2122.1   146.4    2122     148  2122.1   150.7
GR2122.1   156.4  2122.3   158.9  2123.1   168.9    2124   176.7  2124.1     180
GR2124.6     185  2124.6   192.5  2124.8   198.6  2124.9   216.2  2124.7   225.5
GR2124.6   230.6  2124.3   235.8  2124.4   238.1    2124     247  2123.7   250.8
GR2123.2   260.3  2122.7   266.3  2122.1   275.9  2121.9   281.2  2121.7   285.2
GR2120.5   294.8  2120.7   297.7  2121.4   300.2  2121.2   304.4    2122     309
GR2121.9   315.8  2117.2     333  2116.9   336.2  2118.3   356.3  2117.8   361.4
GR2117.8   365.6  2130.2   387.3  2131.1   389.4  2134.9   401.1  2135.3   405.1
GR2135.7   426.3  2135.2   460.7  2132.7   484.1    2132   503.9
HD59.821      10   114.2   365.6
```

CROSS SECTION #RM159.974

```
NC .0321   .0321   .0332
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X159.974      80   114.8   581.2   760.8   760.8   760.8
GR2136.8       0  2136.9      17  2136.5    26.3  2135.8    81.9  2134.4    98.4
GR2133.9    98.7  2134.1    99.3  2133.8   107.5  2133.6   108.1    2134   110.3
GR2134.1   114.8  2133.9   115.6  2130.4   122.5  2123.3   127.3  2121.4   131.6
GR2121.2   131.7  2120.9   133.4  2120.9   138.2  2121.1   138.5  2121.1   139.4
GR2120.7   144.3  2120.5   148.6  2120.5   150.4  2120.3     160  2120.2   160.2
GR2120.2   164.2  2119.9   170.8  2119.5   174.2  2119.6     175  2119.6   181.6
GR2119.7   184.4  2119.7   186.6    2120   189.6    2121   194.7  2121.6   198.1
GR2121.6   198.7  2121.8   201.2  2121.7   201.4  2121.7   202.2  2121.8   203.5
GR2121.8   205.6  2122.3   208.6  2122.6   212.4  2122.6   217.3  2122.7   217.7
GR2122.9   222.8  2122.9   227.4    2123     228  2122.9   232.4  2123.2   233.9
GR2123.2   237.9  2123.4   239.6  2123.3   241.6  2123.3   251.3  2123.1   254.5
GR2123.1   280.7  2123.2   282.2  2123.2   290.6  2123.3   291.5  2123.3   292.8
GR2123.9   299.6  2125.7   312.5  2126.3   320.3  2126.4     325  2125.9   374.4
GR2125.7   378.4  2125.5   388.6  2125.3   391.2  2126.9   403.9  2126.9   413.5
GR2126.7     418  2126.7   418.9  2126.9   419.8  2126.9   421.1  2134.2   497.3
GR2134.9   500.7    2138   565.5  2138.5   581.2  2138.4   636.9    2138   660.1
HD59.974      10   127.3   391.2
```

CROSS SECTION #RM160.144

```
NC .0321   .0321   .0332
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X160.144      80   264.5   635.1   898.6   898.6   898.6
GR2138.3       0  2138.1    23.7  2138.9    61.8  2139.2    63.8  2139.1    88.2
GR2136.7   140.2  2139.1   232.2  2139.6   242.7  2139.2   264.5    2133   277.7
GR2126.5   280.4  2125.2   282.1  2124.8     283  2124.6   283.9  2124.7   286.3
GR2124.6   287.8  2124.2   288.4  2123.3   289.2    2123   290.2  2122.9   292.9
GR  2122   294.1  2121.6   297.4  2121.9   299.7  2121.9   305.9  2122.1   309.7
GR2122.1   311.6  2122.5   314.7  2123.1   325.1  2123.3   331.9  2123.4     337
GR  2124   349.5  2125.2   368.5  2125.2     372  2125.3   373.4  2125.3     375
GR  2125   377.6    2125   381.7  2125.3   390.7  2125.3   404.6  2125.7   426.5
GR2125.9   430.7    2126   443.7  2126.1   447.3  2126.1   462.7  2126.3   464.4
GR2126.3   473.9  2126.1   479.2  2126.3   479.5  2126.3   481.6  2126.1     487
GR2126.1   490.8  2126.2   492.6  2126.1   498.8  2126.1   507.1    2126   508.9
GR  2126     514  2125.7   523.4  2125.8     524  2125.8   526.1  2125.6   527.3
GR2125.6   535.2  2125.2   545.6  2124.5   559.1    2124   563.7  2124.2   569.1
GR2124.7   569.7    2124   570.9  2123.8   571.7  2123.7   576.2  2124.8   584.5
GR2124.9   586.5  2124.3   590.9  2124.2   593.3  2124.4   596.3    2125   601.3
GR2125.3   606.7    2133   617.1  2137.4   635.1  2137.5   644.4    2138   883.2
HD60.144      10   288.4   606.7
```

CROSS SECTION #RM160.340

```
NC .0321   .0321   .0332
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X160.340      80   172.4   427.9  1051.2  1051.2  1051.2
GR2138.5       0  2138.4   172.4  2137.8   175.7  2136.4   176.8  2135.7   179.1
GR2125.8   188.5  2125.8   189.6  2125.5   190.7  2124.8   191.7  2124.2   193.4
GR2123.9   195.6  2123.9   196.6  2123.3   205.2    2123   208.4  2123.2   211.4
GR2123.2     214  2123.5   214.8  2123.3   215.4  2123.3   216.7  2123.2   218.3
GR2123.2   222.6  2123.1   223.5  2123.1   225.6  2123.2   228.1  2123.2     237
GR2123.3   237.4  2123.1   239.3  2123.1   247.2  2123.2   247.8  2123.3   251.3
GR2123.3     259  2123.1   261.2  2123.1     262  2123.3     263  2123.3   267.5
GR2123.4   268.3  2123.4   274.4  2123.6   275.9  2123.6   277.8  2123.9   279.9
GR2123.7   280.7  2123.7   282.9  2123.8   283.8  2123.8   287.4    2124     289
GR  2124   295.4  2124.1   295.7  2124.1   301.3  2124.2   302.3  2124.2   304.4
GR2124.1   306.6  2124.1   307.7  2124.2   309.5  2124.2   321.1  2124.3   321.9
GR2124.2   324.1  2124.2   333.9  2124.1   334.7  2124.1   343.2    2124   343.8
GR  2124   357.3  2123.9   357.9  2124.2   362.7  2123.9   363.1  2123.9   363.8
GR2123.5   366.5  2123.3   369.7  2125.3   375.4  2125.7   377.3  2126.6   378.2
GR2132.3   389.9  2133.6   403.8  2133.7   406.5  2135.8   416.7  2137.1   427.9
GR2137.3   454.8  2137.4   489.5    2137   517.6  2137.2   527.6  2136.4   552.2
HD60.340      10   188.5   375.4
```

CROSS SECTION #RM160.543

```
NC .0321   .0321   .0332
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X160.543      81   203.5   438.1  1085.5  1085.5  1085.5
GR2139.7       0  2139.6    19.2  2139.8    35.5  2141.1    62.3    2140    66.6
GR2139.4    79.4  2139.6    79.5  2144.3   106.4  2144.2   111.4  2140.2   137.4
GR2141.7   159.3  2141.2   203.5  2127.2     221  2127.3   221.3  2126.8   223.7
GR2126.3   225.2  2125.9   225.6  2125.9   225.9  2125.5   227.5  2125.1   232.1
GR2124.6   233.3  2124.1   245.8  2124.1   250.3    2124   254.8  2124.6   257.3
GR2124.9   263.4  2125.1   265.2  2124.8   267.8  2124.8   269.6  2125.3   271.4
GR2125.3   275.2  2125.4   275.4  2125.4   277.3  2125.3   277.9  2125.3   279.4
GR2125.5   282.6  2125.4   283.7  2125.4   289.7  2125.3   290.3  2125.3   298.2
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GR2125.2   302.8  2125.2   306.2    2125   311.8    2125   322.2  2124.9   323.1
GR2124.9   331.1  2124.6     336  2124.6   343.4  2124.4   348.1  2124.4   356.9
GR2124.1   362.2  2124.1   364.7    2124   364.9    2124   366.2  2124.2     368
GR  2124   371.3    2124   377.2  2124.1   378.2  2123.7   380.4    2123   382.5
GR2122.9   384.4  2123.7   387.1  2123.9   388.3  2123.7   389.2  2123.6   391.3
GR2123.7   394.5    2124   397.3  2125.7   398.4  2126.3   399.3  2126.4   401.3
GR2126.9   402.4  2130.9   404.9  2133.8   421.8  2138.2     430  2140.2   438.1
GR2140.6   446.4  2138.1   492.6  2138.8   498.7    2137   595.7  2136.4   622.8
GR2136.4   662.8
HD60.543      10   227.5   397.3
```

CROSS SECTION #RM160.683

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X160.683      80      80   310.3   745.1   745.1   745.1
GR  2172       0  2171.8     1.9  2170.1    35.7  2168.7    39.8  2147.2    64.8
GR2146.4    75.4  2146.5      80  2145.7      84  2137.4    98.9  2133.8     106
GR2132.4   109.5  2129.9   114.1  2127.4   115.2  2127.5     116  2127.2   116.5
GR2127.1   118.5  2126.8   118.8  2126.7   118.8  2126.6   119.8  2126.4   119.8
GR2125.3     121  2125.1   121.5  2125.1   122.1  2123.6   124.9  2123.7     127
GR2124.1   127.7    2124   128.4  2123.3     129  2123.4   131.4  2122.5   137.3
GR2122.6   138.6  2122.4   138.8  2122.1   140.5  2122.4   144.3  2122.3   151.4
GR2122.5     154  2122.5   164.6  2122.7   171.8  2123.1   175.5  2123.2   179.3
GR2123.1     180  2123.4   183.7  2123.3   185.4  2123.3     190  2123.2   192.2
GR2123.2   198.2  2123.3   198.5  2123.3   204.2  2123.6   208.3  2123.4   210.1
GR2123.6   215.5  2123.6   218.4  2123.9   226.4  2123.9   230.5  2124.1   232.9
GR2124.1   237.4    2124   238.3    2124   250.7  2124.2   252.7  2124.2   254.3
GR2124.6     259  2124.6   260.4  2126.5   267.7  2126.6   269.4    2133   273.4
GR2133.7   277.1  2135.1   280.3  2136.4   282.4  2140.1   293.2  2139.9   294.8
GR2141.7   310.3  2141.4   317.9  2140.6   319.8  2139.6   348.2  2139.7   356.4
GR2139.2   359.2  2139.4     369  2138.8   417.5    2139   443.6  2140.1   472.9
HD60.683      10   119.8   269.4
```

CROSS SECTION #RM160.859

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X160.859     116   141.6   418.7   942.6   942.6   942.6
GR2157.7     0.0  2157.5     3.4  2156.7    27.2  2156.5    63.2  2155.8    70.4
GR2144.1   114.7  2143.8   133.4  2143.9   141.6  2142.9   144.7  2135.9   156.6
GR2134.4   159.3  2133.1   162.3  2132.0   165.1  2130.2   168.7  2128.7   169.6
GR2128.7   170.2  2128.5   170.6  2128.3   172.2  2128.0   172.5  2127.8   173.3
GR2127.0   174.2  2126.9   174.6  2126.8   175.1  2126.7   175.4  2126.0   176.4
GR2125.1   177.3  2124.9   178.3  2124.9   179.6  2124.6   184.7  2124.6   188.6
GR2124.7   191.5  2124.6   193.8  2124.6   195.0  2124.2   198.1  2124.2   201.0
GR2124.3   204.7  2124.4   210.2  2124.4   214.4  2124.6   219.2  2124.5   225.1
GR2124.7   231.7  2125.1   233.8  2124.9   236.7  2124.5   238.5  2124.5   240.0
GR2124.4   241.6  2124.1   243.2  2123.8   246.6  2123.8   246.8  2123.6   247.6
GR2123.3   251.8  2123.2   256.2  2123.4   258.4  2123.3   262.5  2123.4   264.0
GR2123.4   270.2  2123.6   274.4  2123.8   276.5  2123.8   279.1  2124.0   281.3
GR2123.9   282.2  2123.9   284.9  2123.8   286.2  2123.9   289.7  2123.9   293.1
GR2124.1   295.5  2124.0   296.6  2124.1   299.7  2124.1   301.4  2124.3   306.0
GR2124.3   308.4  2124.4   309.8  2124.4   312.4  2124.3   312.9  2124.3   320.1
GR2124.5   321.3  2124.5   322.2  2124.7   324.9  2124.9   327.5  2126.0   333.1
GR2126.2   335.3  2126.9   340.6  2126.9   343.9  2130.8   351.2  2131.2   355.1
GR2131.2   355.4  2131.3   356.7  2131.3   358.0  2131.4   360.0  2131.6   361.0
GR2131.7   363.7  2131.7   363.8  2132.6   367.7  2135.6   387.4  2135.7   390.3
GR2135.9   392.9  2135.8   399.6  2135.1   400.0  2138.2   411.6  2138.9   418.7
```

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GR2138.2   427.6  2137.6   429.8  2137.1   438.1  2136.6   463.2  2136.6   472.8
GR2136.3   476.1  2136.4   487.7  2136.1   520.6  2136.7   544.7  2136.9   550.1
GR2136.6   561.1  2139.9   575.3  2141.1   580.3  2140.1   589.7  2141.4   600.1
GR2143.3   609.8
HD60.859      10   170.6   340.6
```

CROSS SECTION #RM161.086

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.086      50   220.9   751.1  1214.8  1214.8  1214.8
GR2139.3       0  2138.2    42.4  2140.6   220.9  2132.8   232.8    2129   243.6
GR2128.4   244.3  2127.1   244.9  2126.6   246.9  2126.6   249.6  2125.9   259.8
GR2125.7   267.9  2125.3   278.4  2125.3   293.1  2125.6   300.5  2125.9   320.3
GR2126.4   330.1  2126.4     342  2127.3   355.5  2128.1   359.7  2127.8   365.7
GR2127.1   369.3  2126.9   375.7  2126.2   378.9  2125.3   386.1  2124.6   396.3
GR2124.6   405.3  2124.8   409.9  2126.7   422.8  2126.8   426.3  2127.4   434.7
GR2127.2   439.3  2128.3   457.6  2128.4   458.1  2128.4   460.2  2127.9   465.4
GR2127.9     467  2127.3   471.3  2130.5   517.5  2129.8   528.1  2128.1   528.7
GR2134.2   547.2  2135.2   558.3  2132.8   581.5  2132.3   679.8  2134.3     715
GR2133.7   728.2  2143.6   751.1  2140.9   762.2  2143.4   774.6  2147.4   786.2
HD61.086      10   244.9   471.3
```

CROSS SECTION #RM161.175

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.175      50   275.3   582.5   479.7   479.7   479.7
GR2139.1       0  2139.1      92  2138.1   100.8  2138.1   163.3    2140   175.6
GR2139.4   191.6  2135.5   220.7  2133.8     265  2136.4   275.3  2133.7   297.3
GR2134.8   304.5  2134.1   316.3  2126.6   330.4    2126   333.3  2127.2   338.6
GR2127.8   344.2  2128.3   347.1  2128.8   359.3  2128.8   364.7  2128.6   371.4
GR2128.7   383.5  2128.4   387.3  2128.6   400.1  2128.3   403.8  2128.4   412.3
GR2127.9   421.4  2128.8   427.2  2128.8   440.4  2128.5   447.4  2128.5   455.9
GR2127.6   474.6  2127.7   476.2  2127.5   479.3  2127.2   480.7  2126.1   491.1
GR2125.3   511.2  2125.4   516.5  2125.4     523  2125.2   526.3  2125.2   532.6
GR2125.4   533.5  2128.1   535.7  2128.8   538.1  2128.3   538.5  2135.6   551.9
GR2136.8   582.5  2136.5   616.9  2136.4   636.8  2135.5   669.8  2136.4   795.3
HD61.175      10   330.4   535.7
```

CROSS SECTION #RM161.256

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.256      50   569.6     891   436.1   436.1   436.1
GR2136.4       0    2139    11.5  2139.7    29.6  2135.5    63.4  2131.2      81
GR  2131    95.5  2135.5   113.9  2139.1   155.5  2138.4   185.5  2141.1   248.9
GR2142.1   262.6  2136.3   458.6  2130.4   497.5  2130.5     507  2137.2   551.6
GR2138.1   569.6  2136.8   590.5  2137.4   608.5  2135.9   632.2  2133.6   651.8
GR2133.9   685.6  2131.8   690.5  2123.9   698.9  2123.5   706.6  2126.1   736.1
GR2126.7   747.8  2126.9   758.9  2127.3   767.1  2127.2   818.8  2127.5   833.6
GR2127.4   839.1  2128.6   841.5  2128.7   845.9  2133.7   851.1  2135.5   859.4
GR2137.4     891  2136.3   970.8  2132.6   995.4  2134.5    1000  2135.7  1050.3
GR2140.5  1069.8  2141.2  1207.2  2139.6  1241.4  2140.4  1278.8  2137.4  1395.5
GR2140.4  1413.6  2141.2  1446.4  2140.8  1492.5  2141.7    1518  2140.9  1530.6
HD61.256      10   698.9   845.9
```

CROSS SECTION #RM161.442

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
```

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X161.442      50   305.8   519.4   999.8   999.8   999.8
GR2140.7       0  2141.4     8.7  2142.7    46.5  2141.4    63.6  2143.2    96.4
GR2139.5   107.7  2138.1   114.2  2138.8   115.7  2137.8   122.4  2138.6   144.5
GR2138.2   146.4  2132.3   207.6  2135.3   225.2  2134.2   268.6  2133.5   274.3
GR2134.9   284.5  2134.6   286.9    2135   305.8  2133.9     316  2130.9   325.8
GR2129.3   328.3  2126.5   328.8  2126.5   329.9  2126.9   331.7    2127   340.3
GR2127.3   347.5  2128.1   381.9  2128.4   388.9  2128.4   395.1  2128.8   403.6
GR2129.3   418.5  2129.3   435.9  2128.7   450.8  2128.7   458.6  2128.8   465.5
GR  2129   466.1    2129   467.7  2129.4   475.7  2129.4   478.8  2134.2   499.7
GR2137.1   519.4    2135   558.8  2132.6   564.4  2134.2     627  2136.7   657.8
GR2137.3   678.2  2139.9   728.2  2139.8   733.6  2138.4   750.3  2139.3   767.5
HD61.442      10   328.3   478.8
```

CROSS SECTION #RM161.534

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.534      50   301.3   831.4   496.3   496.3   496.3
GR  2146       0  2144.6     8.7  2142.1      38  2142.9    46.4  2137.2    76.5
GR2139.6    97.6  2141.9   111.3  2139.5     136  2140.2   152.6  2142.3   223.7
GR2142.6   301.3  2142.1   325.8  2133.7   375.4  2129.4   379.9  2129.6   383.4
GR  2129   388.1  2125.4   400.1  2124.6   404.8  2124.4   410.2    2125     424
GR2125.6   430.2  2127.5   441.4  2128.4   449.1  2128.9   457.3  2128.6     473
GR2127.4   479.7  2126.6   491.2  2126.7   497.5  2127.2   499.2  2127.3   512.1
GR2128.2     516  2130.4   517.2  2133.2   565.8  2134.1   569.3    2131   637.6
GR2131.3   651.1  2133.7   651.8  2135.1     663  2134.9   668.5  2139.8   831.4
GR2138.3   853.2  2140.3   906.8  2137.6   996.2  2134.1  1016.6  2130.3  1032.2
GR2130.5  1054.9  2134.2  1066.1  2136.8  1096.2    2146  1175.4  2144.7    1196
HD61.534      10   383.4   517.2
```

CROSS SECTION #RM161.705

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.705      46       0     445   915.8   915.8   915.8
GR2137.5       0  2137.2      14  2133.7      21  2133.7      30  2132.1      50
GR2129.7      69  2127.2      70    2129      90  2129.7     130  2129.4     150
GR2129.6     170  2129.3     190  2129.6     210  2129.6     228  2128.7     232
GR2127.7     241 2126.98     242  2126.6     250  2126.7     260  2126.9     270
GR2126.1     280  2125.1     290  2124.8     300  2124.7     310  2124.9     320
GR2124.1     330  2123.4     340  2123.8     350 2126.99     354  2130.3     356
GR2131.2     379  2131.5     385  2131.8     400  2133.2     415  2134.2     428
GR2136.1     438  2136.4     445  2136.1     460  2140.2   476.5    2136   508.5
GR2137.5   522.3  2138.1   554.8  2139.7   565.4  2139.9   576.4  2141.8   618.5
GR2141.5   630.4
HD61.705      10    69.0   350.0
```

CROSS SECTION #RM161.873

```
NC .0321   .0321   .0452
NV    24  -0.033    6440  -0.027   22000  -0.023   25500  -0.023   41000
X161.873      49      13     277   903.8   903.8   903.8
GR2142.6       0  2141.7       9  2135.5      13  2133.4      24  2132.6      27
GR2132.4      37  2132.2      47    2132      57  2131.6      67  2130.8      77
GR2129.6      87  2129.3      97  2129.1     107    2129     117  2129.3     127
GR  2130     137  2130.6     147  2130.9     157  2131.1     167  2131.5     177
GR2131.8     187  2132.3     197  2132.6     203  2132.7     217  2132.1     237
GR2134.9     257  2136.5     277  2136.4     297  2135.9     317    2135     337
GR2135.9     357  2133.9     377  2135.5     397  2136.4     417  2135.4     437
GR2136.2     457  2135.4     477  2134.8     497  2136.4     517  2137.1     537
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GR2136.5     557  2133.3     577  2135.5     597  2136.6     617  2136.2     637
GR2133.8     657  2133.7     677  2137.1     697  2142.5     717
HD61.873      10    27.0   237.0

   CROSS SECTION #RM162.041
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.041      53       0   344.1   904.7   904.7   904.7
GR2152.7       0  2141.8    47.3  2136.8      58  2132.6    61.2  2132.6    62.3
GR  2132    63.3  2130.6    68.8  2130.1    72.3  2130.1    82.1  2130.4    85.8
GR2130.6    86.9  2130.6    90.5  2130.7    90.7  2130.1   105.1  2130.1   106.8
GR2129.6   112.1  2129.6   118.2  2129.8   126.9  2129.8   135.7  2129.9   140.2
GR2129.7   151.3  2129.3   165.7  2129.3   172.7  2129.1   172.9  2129.1   174.1
GR2128.3   195.3    2128   197.7  2127.1   211.4  2126.8   214.3  2126.6   225.2
GR2126.6   227.5  2126.1   237.1  2126.2     240  2126.1   245.2  2128.4   268.5
GR2129.2   277.6  2129.6   284.1  2129.9   292.8  2129.9   296.6  2130.4     312
GR2130.4   316.9  2130.6   320.9  2130.6   332.6  2131.1   336.6  2131.6   337.6
GR2132.3   337.6  2132.8   338.1    2133   342.4  2133.4     343  2136.7   344.1
GR2138.4     348 2143.19     349 2145.67     360
HD62.041      10    68.8   336.6

   CROSS SECTION #RM162.081
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.081      33      -7     310   214.8   214.8   214.8
GR2154.5      -7  2150.9       0  2137.4      34  2134.5      37  2132.1      41
GR  2128      51  2124.6      61  2126.1      71  2124.1      81  2121.6      91
GR2120.6     101  2118.6     111  2117.6     121  2117.6     131  2116.6     141
GR2116.6     151  2116.6     161  2115.6     171  2115.6     181  2115.6     191
GR2116.6     201  2117.6     211  2119.6     221  2120.6     231  2121.6     241
GR2123.6     251  2124.6     261  2126.4     271  2129.8     281  2134.5     289
GR2138.5     298  2143.2     299  2145.7     310
HD62.081      10    51.0   271.0

   CROSS SECTION #RM162.133
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.133      56       0     320   281.6   281.6   281.6
GR2146.4       0  2141.8    13.6  2139.6    15.1  2136.8      20  2131.6      26
GR2131.3    27.4  2131.3    28.3  2131.5    29.2  2130.9    29.5  2130.7    30.7
GR2129.9    34.3  2130.1    35.4  2129.8      42  2129.9    47.8  2130.1    49.9
GR2130.3    50.2  2130.8    57.5  2130.8    70.9  2130.7    72.8  2128.4    90.7
GR2128.1    91.3  2123.3     105  2121.2     109  2119.9   112.8  2119.7   113.9
GR2119.1   114.9  2114.4   134.8    2114     135  2112.7   139.8  2103.1   166.3
GR2100.6   174.6  2099.7   180.4    2098     203  2097.9   208.5  2098.2   212.5
GR2098.5   214.5  2101.9     227  2102.5   230.3  2102.4   231.1  2111.9     248
GR2115.8   252.8  2116.8   254.2  2116.4   254.4  2118.2   256.2  2122.2   264.6
GR  2123   267.6  2123.9   269.7  2123.5   270.4  2124.4   271.3  2124.8   272.3
GR2126.3     281 2129.79     291 2134.54     299 2138.49     308 2143.19     309
GR2145.6     320
HD62.133      10    90.7   281.0

   CROSS SECTION #RM162.295
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.295      58     137   338.5   869.7   869.7   869.7
GR  2145    -450    2140    -125  2139.3    -105  2138.4     -85  2138.5     -65
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GR2138.6     -45  2138.9     -25  2139.2      -5  2137.5    93.4  2137.3     137
GR2133.5   138.5  2133.6   138.9  2133.3   140.2  2132.1   142.1  2131.6   143.6
GR2130.7   143.9  2129.6   144.2    2129   144.6  2127.7   147.1  2127.3   147.5
GR2125.3   150.3  2124.6   152.8  2124.6   155.4  2124.2   155.6  2124.1   156.2
GR2123.5   157.3  2123.1   159.5  2123.9   164.2    2125   177.4  2126.1   198.9
GR2126.1   200.6  2126.3   201.5  2126.2   206.8  2126.8   226.3    2127   236.8
GR2127.2     243  2127.1   245.4  2127.1   249.2  2126.4   259.8  2126.4   263.9
GR2125.8   267.3  2125.7   275.4  2126.6   283.1    2128   291.4  2128.4     296
GR2128.6   302.1  2128.6     306  2128.5   314.3  2128.5   315.8  2128.3   318.1
GR2128.2   321.6  2128.3   322.7  2128.7   323.4  2129.8   324.1  2132.3   327.4
GR2137.2   338.5    2141     350    2144     355
HD62.295      10   150.3   323.4
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CROSS SECTION #RM162.413

```
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.413      56       0   222.3   637.2   637.2   637.2
GR  2145  -189.5  2139.2   -73.5  2137.6       0  2136.7    45.8  2135.1    68.5
GR2133.8    72.2  2132.4      84  2132.4    84.6  2133.2      85  2133.1    86.1
GR2132.6    86.9  2133.6    87.7  2133.6    89.6  2133.4    90.3    2133    96.9
GR  2133    99.5  2132.8     100  2132.2   106.7  2131.9   108.5  2131.6   111.7
GR2131.1   113.3  2130.7   115.6  2125.6   127.4  2124.4   129.9  2122.3   136.6
GR2120.1   142.8  2118.4   147.9    2118   153.5  2119.3   158.5  2119.6   162.4
GR2121.9   174.2  2122.9   180.5  2122.9   181.4  2123.8   185.1  2124.1   186.8
GR2126.3     187  2127.1   188.8  2126.9   189.9  2127.3     190  2127.1   190.6
GR2127.1   192.1  2127.4   192.2  2127.3   192.7  2127.6   192.7  2128.2   192.9
GR2128.3   193.2  2131.2   193.5  2131.4   193.7  2131.8     196  2133.9   196.1
GR2133.7   198.1  2133.7   202.3    2137   222.3    2137   242.3    2133   331.5
GR  2145   558.2
HD62.413      10   106.7   196.0
```

CROSS SECTION #RM162.506*

```
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.506      98     2.2   207.3   502.3   502.3   502.3
GR2145.5  -145.4  2140.4     -55  2138.8     2.2  2137.9     4.8    2137    38.7
GR2136.3    47.6  2135.6    49.7  2135.1    56.8  2134.1    59.8  2133.7    62.8
GR2133.5    64.9    2133    69.2    2133    69.9  2133.6    70.3  2133.5    71.6
GR2133.3      72  2133.2    72.3  2133.1    72.5  2133.5    73.1  2133.8    73.4
GR2133.9    73.5    2134    75.1    2134    75.7  2133.8    76.5  2133.8    78.2
GR2133.7    80.7  2133.6    81.6  2133.5    84.1  2133.5    87.1  2133.3    87.7
GR2133.1    90.6    2133    90.8    2133    91.2  2132.8    94.2  2132.6    95.5
GR2132.3    97.6  2132.3    97.8  2132.2    98.7    2132   101.3  2131.6   103.1
GR2131.2   105.8  2127.7   117.3  2126.9   119.5  2126.8   119.8    2126   122.4
GR2125.5   124.8  2124.9     127  2124.6   128.2  2124.1   130.1  2122.1   137.3
GR2120.5   143.2  2120.4   144.8  2120.3     146  2119.9   149.7    2121   153.9
GR2121.2   157.2  2121.3   157.9  2121.5   158.8  2123.4   167.1  2124.3   171.6
GR2124.4   172.3  2124.4   172.8  2124.7   173.1  2124.9   173.2  2125.4   175.2
GR2125.6   175.6  2125.6   176.2  2125.7   176.6  2125.7   176.8    2126   177.6
GR2127.7   177.8  2128.5   179.2  2128.6   179.3  2128.5   179.7  2128.7   179.7
GR2128.6   180.2  2128.9   180.3  2128.8   180.8  2128.8     182  2129.1   182.1
GR  2129   182.5  2129.7   182.7  2129.8     183    2132   183.2  2132.1   183.4
GR2132.5   185.2  2132.5   185.3  2134.1   185.4    2134   187.1  2134.1   190.6
GR2134.6   193.4  2135.3   195.1    2138   207.3  2138.1   225.8  2135.3   308.3
GR2137.1   347.7  2141.2   431.8  2145.5   517.9
HD62.506      10    94.2   185.2
```

CROSS SECTION #RM162.599*

```
NC .0361   .0361   .0481
NV     24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.599       96     4.4   192.4   502.3   502.3   502.3
GR  2146  -101.2  2142.4   -48.2  2141.7   -36.5    2140     4.4  2138.2     6.3
GR2137.3    31.7  2136.8    38.2  2135.5    39.8  2135.1    45.1  2134.4    47.3
GR2134.1    49.6  2133.9    51.2  2133.5    54.3  2133.5    55.1  2133.9    55.7
GR2133.8    57.1  2133.7    57.6  2133.6    57.9  2133.6    58.2  2133.9    58.8
GR  2134    59.1  2134.1    59.2  2134.4      61  2134.4    61.7  2134.3    62.7
GR2134.3    64.6  2134.2    67.5  2134.1    68.5  2134.1    71.8    2134    72.6
GR2133.9    74.8  2133.8    75.4  2133.5    78.7  2133.5    79.4  2133.3    82.8
GR2133.1    84.3  2132.8    86.6  2132.7    86.9  2132.6    87.9  2132.4    90.9
GR  2132      93  2131.7      96  2128.9   109.1  2128.3   111.6  2128.2     112
GR2127.6   114.8  2127.2   117.6  2126.7   120.1  2126.4   121.5    2126   123.7
GR2124.1   131.8  2122.7   138.6  2122.5   140.4  2122.4   141.7  2121.9   145.9
GR2122.6   149.3  2122.8     152  2122.9   152.5    2123   153.3  2124.9   159.9
GR2125.9   163.5  2125.9   164.5  2126.5   164.8  2126.9   164.9  2127.4   166.4
GR2127.5   166.8  2127.3   167.2  2127.4   167.3  2127.4   167.6  2127.5   167.8
GR2127.9   168.4    2129   168.5    2130   169.7    2130   169.8  2130.3   170.1
GR2130.3   170.5  2130.5   170.6  2130.4     171  2130.7     172  2130.7   172.4
GR2131.2   172.5  2131.2   172.7  2132.7   172.9  2132.8   173.1  2133.2   174.6
GR2134.3   174.7  2134.3     176  2134.4   178.9  2134.9   181.1    2136   182.5
GR2139.1   192.4  2139.2   209.3  2137.6   285.1    2139   321.2  2142.4   398.6
GR  2146   477.6
HD62.599       10    87.9   172.9
```

CROSS SECTION #RM162.692*

```
NC .0361   .0361   .0481
NV     24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.692       94     6.7   177.4   502.3   502.3   502.3
GR2146.5   -57.1  2143.5   -25.1  2142.9   -18.1  2141.2     6.7  2138.5     7.9
GR2137.6    24.6  2137.2    28.9  2135.4      30    2135    33.5  2134.6    34.9
GR2134.4    36.4  2134.4    37.4  2134.1    39.5  2134.1    40.4  2134.3      41
GR2134.2    42.6  2134.1    43.1  2134.1    43.5    2134    43.8  2134.2    44.5
GR2134.3    44.9  2134.4      45  2134.7      47  2134.7    54.2  2134.6    55.4
GR2134.6      59  2134.5      60  2134.4    62.4  2134.3    63.2    2134    66.8
GR2133.9    67.1  2133.9    67.6  2133.7    71.4  2133.5    73.1  2133.2    75.7
GR2133.2      76    2133    77.2  2132.7    80.4  2132.5    82.8  2132.2    86.2
GR2130.2   100.8  2129.6   103.6  2129.5   104.1  2129.2   107.3  2128.9   110.4
GR2128.5   113.2  2128.2   114.7  2127.8   117.2  2126.1   126.4  2124.8   133.9
GR2124.5   135.9  2124.5   137.4  2123.9   142.2  2124.3   144.7  2124.4   146.7
GR2124.4   147.2  2124.5   147.7  2126.4   152.8  2127.4   155.5  2127.5     156
GR2127.5   156.3  2128.4   156.4  2128.8   156.5  2129.3   157.7  2129.4     158
GR2129.1   158.3  2129.2   158.6  2129.2   158.7  2129.7   159.2  2130.4   159.3
GR2131.5   160.2    2132   160.5    2132   160.8  2132.1   160.8  2132.1   161.2
GR2132.3   161.9  2132.4     162  2132.4   162.2  2132.7   162.3  2132.7   162.5
GR2133.5   162.6  2133.5   162.7  2133.9   163.9  2134.4     164  2134.5     165
GR2134.8   167.1  2135.2   168.9  2136.8   169.9  2140.1   177.4  2140.2   192.9
GR2139.9   261.9  2140.8   294.8  2143.5   365.3  2146.5   437.3
HD62.692       10    71.4   162.6
```

CROSS SECTION #RM162.786

```
NC .0361   .0361   .0481
NV     24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.786       53     8.9   162.4   502.3   502.3   502.3
GR  2147     -13  2144.6      -2  2142.4     8.9  2138.8     9.5  2137.6    19.6
GR2135.3    20.1  2134.8    23.2  2134.8    23.7  2134.7    24.7  2134.5    28.7
```

```
GR2134.5    29.1  2134.6    30.2  2134.6    30.6  2135.1      33  2135.2    37.4
GR2135.2      41  2135.1    42.3  2135.1    46.3    2135    47.4  2134.5    54.9
GR2134.4    55.2  2134.4    55.8  2134.2      60  2133.6    65.1  2133.4    66.4
GR2131.4    92.6  2130.9    96.2  2130.6   103.2  2130.3   106.3    2130     108
GR2126.6   131.5  2126.6   133.1  2125.8   138.4    2126   141.8    2126   142.2
GR  2129   147.5    2129     148  2130.8   148.2  2131.2     149  2131.3   149.2
GR2130.9   149.4    2131   149.6    2131   149.7  2132.9   150.7  2133.1   150.9
GR2133.6   150.9  2134.6   153.2  2135.5   156.6  2137.5   157.3  2141.1   162.4
GR2142.7   268.4  2144.7     332    2147     397
HD62.786      10    54.9   153.2
```

CROSS SECTION #RM162.948*   CATALDO GAGING STATION

```
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X162.948      52       0   226.7   871.8   871.8   871.8
GR  2148     -20  2143.5       0  2140.4     3.7  2139.8     5.3  2136.3       7
GR2135.5     9.3  2135.2      11  2135.1    11.3  2132.6    13.7  2132.2    16.6
GR2131.7      19  2131.6    19.4  2131.8    19.9  2131.3    24.8  2131.1    25.2
GR2128.8    34.5  2128.5      36  2126.9    41.8  2126.3    47.6    2126    52.3
GR2126.1    52.9  2126.9    74.2  2127.2    75.5  2127.2    76.2  2127.7    82.2
GR2128.1    84.2  2129.5   102.6  2130.8   117.2  2132.2   136.9  2132.2   138.4
GR2133.1   151.7  2133.1   156.6  2133.6   159.9  2133.6   164.8  2133.8     167
GR2134.2   173.9  2134.4   174.3  2134.4   175.9  2135.1   181.9  2135.1   182.8
GR2135.4   183.4  2135.4     187  2135.5   187.6    2136     193    2136   197.4
GR2136.2   199.8  2136.2   202.9  2135.9   209.3  2136.2     210  2139.7   214.3
GR2143.9   226.7    2148     250
HD62.948      10    11.0   181.9
```

CROSS SECTION #RM163.069

```
NC .0361   .0361   .0481
NV    24  -0.045    6440  -0.031   22000  -0.028   25500  -0.028   41000
X163.069      52       0   226.7   669.8   669.8   669.8
GR  2148     -20  2143.5       0  2140.4     3.7  2139.8     5.3  2136.3       7
GR2135.5     9.3  2135.2      11  2135.1    11.3  2132.6    13.7  2132.2    16.6
GR2131.7      19  2131.6    19.4  2131.8    19.9  2131.3    24.8  2131.1    25.2
GR2128.8    34.5  2128.5      36  2126.9    41.8  2126.3    47.6    2126    52.3
GR2126.1    52.9  2126.9    74.2  2127.2    75.5  2127.2    76.2  2127.7    82.2
GR2128.1    84.2  2129.5   102.6  2130.8   117.2  2132.2   136.9  2132.2   138.4
GR2133.1   151.7  2133.1   156.6  2133.6   159.9  2133.6   164.8  2133.8     167
GR2134.2   173.9  2134.4   174.3  2134.4   175.9  2135.1   181.9  2135.1   182.8
GR2135.4   183.4  2135.4     187  2135.5   187.6    2136     193    2136   197.4
GR2136.2   199.8  2136.2   202.9  2135.9   209.3  2136.2     210  2139.7   214.3
GR2143.9   226.7    2148     250
HD63.069      10    11.0   181.9
```

CROSS SECTION #RM163.230

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X163.230      51    44.8   353.4   916.7   916.7   916.7
GR2149.8       0  2146.5    21.5  2142.1    44.8  2140.2    52.8  2136.3    61.4
GR2136.6    67.7  2136.4    74.3  2136.4    77.7  2136.1    81.1  2136.1    86.3
GR  2136    87.2  2136.1    92.2  2136.3    94.9  2136.3    98.9  2136.7   103.6
GR2136.7   105.6  2136.6   106.2  2136.7   112.2  2136.5   119.5  2136.5   125.9
GR2136.6   126.2  2136.6     128  2136.4   131.1  2136.4   134.8  2136.5   146.3
GR2136.5   152.8  2136.6   154.2  2136.6   161.7  2136.4   166.2  2136.4   181.3
GR2136.3   181.6  2135.9   195.8  2135.9   199.2  2135.4   203.4  2135.5     210
GR2135.2   220.3  2135.1   232.3  2135.3   234.1  2135.2   237.5  2135.1   237.7
```

```
GR2135.2   244.6  2135.7   250.3  2135.6   251.7  2135.9     256  2135.8   259.9
GR2136.1   262.2  2136.1   297.1  2139.9   302.8  2140.9   335.8  2142.8   353.4
GR  2150   403.4
HD63.230      10    61.4   297.1
```

CROSS SECTION #RM163.355

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X163.355      50   192.7   351.2   706.7   706.7   706.7
GR2172.8       0  2146.1   155.8  2142.5   189.5  2144.3   192.7  2140.7   210.2
GR2140.9   210.6  2137.9   211.1  2137.1   217.1  2136.6   221.6  2136.6   228.2
GR2136.5   229.2  2136.5   231.6  2136.3   233.8  2136.3   234.9  2136.1   237.2
GR2135.6   242.1  2135.6   246.3  2135.3   249.4  2135.3   251.8  2135.1   258.4
GR2135.1   264.8    2135   266.8    2135   271.5  2135.2   271.8  2135.2   273.4
GR2135.4   274.6  2135.6     279  2135.6   280.4  2135.5   281.2  2135.5   292.1
GR2135.6   292.3  2135.6   294.8  2135.3   297.2  2135.6   299.2  2135.4   300.4
GR2135.4   321.1  2135.6   321.4  2135.8   325.6  2135.8   327.3  2135.7   328.7
GR2136.1   330.6  2136.1   331.3  2136.8   333.1  2136.8   333.6  2137.3   335.6
GR2137.3   336.1  2140.9   344.1    2145   351.2  2149.6     546  2152.1   597.9
HD63.355      10   211.1   336.1
```

CROSS SECTION #RM163.800

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X163.800      54     -20   232.2  2518.3  2518.3  2518.3
GR2148.2     -20  2146.9   -11.6  2143.5       0  2139.4    11.5  2139.5    12.1
GR2139.4    12.9  2138.9    13.7  2137.7    14.4    2137    15.1  2135.5      19
GR2133.2    30.8  2132.1    37.9  2131.2    44.3  2129.6    58.4  2128.8      62
GR2128.7    68.9  2127.7    82.3  2126.3    90.6  2124.3    99.5  2115.8   127.3
GR2114.6   136.7  2114.3     140  2114.9   151.4  2114.8   153.4  2116.4   156.6
GR2116.5   161.9  2118.8   170.7  2118.6   171.2  2120.9   172.2  2121.5     179
GR2125.2   184.2  2125.2   184.7  2125.5   186.5  2127.6   186.9  2128.2   188.5
GR2128.2   189.2  2128.7   191.3  2129.6     192  2129.8   192.7  2129.8     195
GR2130.4     196  2130.7   198.6  2132.5   201.2  2132.4   201.5  2135.8   202.8
GR2136.8   205.5  2138.8   206.2  2138.7   207.4  2138.8   207.5  2139.3   207.8
GR2139.6   211.4  2143.7   217.4  2146.5     220  2154.8   232.2
HD63.800      10    30.8   201.2
```

CROSS SECTION #RM163.901

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X163.901      50       0   297.3   575.8   575.8   575.8
GR2143.4       0  2139.1    11.8  2138.5    14.9  2138.3    16.5  2138.3      18
GR  2138    19.6  2138.1      21  2137.9    22.7  2137.9    27.6  2138.2    37.3
GR2138.2    40.6    2138      49  2137.5    61.1  2136.9    72.2  2136.9    75.3
GR2136.7    76.9  2136.8    78.1  2136.2      87  2136.1    87.2  2136.1    91.1
GR2135.7    98.1  2135.7   104.9  2134.4   125.2  2133.3   136.9  2131.4   150.5
GR  2131   154.4  2131.1   161.8  2131.4   163.4  2131.8   167.1  2131.6   173.3
GR2130.4   188.5  2130.2   200.4  2130.1   201.8  2130.3   207.2    2131   213.3
GR2131.2   219.1  2130.7   230.2  2131.4   247.8  2131.2     254  2130.6   263.7
GR2132.6   272.7  2132.9   275.2  2132.9   276.2  2132.8   276.6  2133.2   278.5
GR2133.7   279.3  2135.2     285  2136.2   287.3  2138.2   290.2  2143.5   297.3
HD63.901      10    49.0   285.0
```

CROSS SECTION #RM163.973

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
```

```
X163.973      50       0   249.6     409     409     409
GR2143.5       0  2140.6     1.2  2139.3     1.4  2138.7     1.6  2138.3     4.1
GR  2138     4.7  2136.6    13.8  2136.4    14.7    2136    20.9  2135.7    22.6
GR2135.1    27.7  2135.1    29.4  2134.8    34.4  2134.4    37.7  2134.4    40.4
GR2133.8    45.8  2133.5    61.6  2132.9    64.3  2132.9    67.8  2132.8      68
GR2132.5    78.2  2132.4    79.2  2132.4    91.1  2132.3    94.8  2132.3   114.3
GR2132.4   122.2  2132.3   131.8  2132.7   138.2  2133.3   146.3  2133.5   147.3
GR2133.4   148.6    2135   176.8  2134.8   178.3  2134.9   179.7    2135   185.7
GR2135.4   189.9  2135.4     193    2136   200.9  2135.9   201.9  2136.2   206.5
GR2136.2   210.2    2136   211.5  2135.9   214.8    2136     216  2135.1   228.1
GR2135.1   230.2    2135     232    2135   241.4  2136.9   244.5  2143.4   249.6
HD63.973      10    13.8   241.4
```

CROSS SECTION #RM164.137

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X164.137      15       0   223.7   979.6   979.6   979.6
GR2143.3       0  2141.1     7.6    2141     7.6  2139.3    10.3  2132.2      22
GR2129.4    30.9  2128.2    44.4  2128.1    62.9  2129.8      86  2133.7   147.1
GR  2135   171.3  2136.3   190.9  2136.7   199.8  2139.5   209.2  2147.8   223.7
HD64.137      10    22.0   199.8
```

CROSS SECTION #RM164.236

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X164.236      50       0   247.3   591.3   591.3   591.3
GR2147.2       0  2143.5     4.8  2139.5    14.3  2139.5    15.1  2137.7    18.8
GR2135.7    19.4  2135.6    22.7  2132.4    27.8  2132.3    29.1  2133.1    33.6
GR  2133    37.1  2133.6    39.8  2133.7    45.3  2133.1    80.5  2132.9    82.3
GR2132.3   125.5  2132.1   128.8  2133.1   151.4  2133.1   158.8  2133.6   160.3
GR2133.6   163.8  2134.5   167.1  2134.3   169.3  2134.4     171  2135.3   174.1
GR2135.3   175.5  2135.5   176.3  2135.4   179.2  2136.4   182.3  2137.1   188.7
GR2137.9   193.6  2138.1   195.7  2138.2   199.6  2137.3     207  2137.4   207.2
GR2137.3   208.8    2136   213.3  2135.4   218.9  2135.4   220.7  2138.1   224.7
GR2139.2   225.5  2139.5   226.3  2139.1   227.5  2139.8   230.2  2143.4   231.9
GR2143.5   234.5  2148.7   247.3    2150   253.2    2156   261.1  2153.4   261.7
HD64.236      10    22.7   220.7
```

CROSS SECTION #RM164.716

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X164.716      50       0   279.9  2899.0  2899.0  2899.0
GR2149.5       0  2146.9    40.1  2145.1    42.5  2141.7    57.6  2141.6    60.1
GR2141.6      66  2141.4    66.7  2141.4    69.2  2141.2    75.7  2140.7    81.7
GR2140.9    85.2  2140.6    86.6  2140.8    87.5  2140.6    87.9  2140.6    91.9
GR2140.4    93.4  2140.5    95.6  2140.2   100.3  2140.3   100.8  2140.3   107.3
GR2140.2   108.1  2140.2   118.2  2139.9   122.7  2139.9   127.1  2140.1   128.7
GR2140.1   134.8  2140.6   152.9  2140.6     157  2140.7   159.4  2140.7   168.1
GR2140.9     171    2141   171.4  2141.4   181.9  2141.4   188.1  2141.7   193.2
GR2141.7   196.1    2142   209.9  2141.9   228.3  2141.6   233.9  2141.6   236.1
GR2140.7   246.6  2140.6     247  2140.4   253.2  2140.4   263.1  2140.8   264.6
GR2141.2   264.7  2141.6   265.1    2142   266.8    2142   272.4  2145.9   279.9
HD64.716      10    57.6   272.4
```

CROSS SECTION #RM164.777

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
```

```
X164.777      45    11.3   187.7   363.5   363.5   363.5
GR  2152       0  2152.1      .4  2151.9     4.1  2148.8    11.3    2146    11.6
GR2141.9    16.7  2141.7    18.6  2141.7    21.4  2141.6    22.8  2141.4      23
GR2141.3    27.8  2141.3    30.7  2139.8    46.9  2139.8    47.6  2139.3    53.1
GR2138.7    63.7  2137.8    70.6  2136.6    75.1  2135.8      77  2134.9    81.8
GR2128.1   114.5  2127.2   128.8  2126.1     138  2125.8     143  2126.2   144.2
GR2126.2   144.9  2125.7   146.9  2126.7   148.7  2126.4   151.5  2128.1   156.4
GR2128.7   156.6  2128.9   157.5  2128.8   158.6  2130.6   160.8  2130.7   161.5
GR2137.1   162.2  2137.1   162.5  2138.9   162.5    2139   162.6    2139     163
GR  2139   163.2  2139.6   163.7  2155.4   187.72156.056  188.33  2162.9   194.9
HD64.777      10    16.7   161.5
```

CROSS SECTION #RM164.917

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X164.917      47       0   251.8   848.6   848.6   848.6
GR2149.3       0  2147.6    65.5  2146.1    71.8  2142.6    81.3  2142.5    85.3
GR2142.6    86.6  2142.4    95.7  2142.2    97.2  2142.3    97.2  2142.3    98.7
GR2141.8   103.9  2141.8   106.4  2141.1     113  2141.1   115.5    2141   116.8
GR2140.1   123.5  2139.7   130.3  2139.3   133.3    2139   137.5  2138.7   140.1
GR2138.1   149.1  2137.8   151.4  2137.5   152.9  2137.5   161.4  2137.1   165.9
GR2136.6   176.7  2136.7     179  2136.2   180.4  2134.8   196.6  2133.8   201.3
GR2133.3   206.3  2134.2   212.4  2134.3   216.1  2136.4   223.9    2137   224.7
GR2138.1   227.7  2137.8   228.4  2138.9   230.6    2140   231.9  2140.4     232
GR2141.5   234.3  2141.7   234.9  2141.6     235  2143.9   236.2  2155.1   251.8
GR2161.3   292.2  2191.2   315.1
HD64.917      10    81.3   227.7
```

CROSS SECTION #RM165.042

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.042      49       0   171.5   774.9   774.9   774.9
GR2149.8       0  2149.8      .2  2146.3      .3  2146.4     1.2  2146.5     1.8
GR2142.1     5.2  2141.7       6  2140.4    13.4    2140    16.3  2139.3    24.6
GR2138.3    29.4  2138.1    34.9  2137.4    43.3  2137.4    44.8  2136.4    52.6
GR2135.4    57.7  2134.4    65.9    2134    66.7  2133.1    73.1  2132.3    77.9
GR2129.3    94.5  2128.9    97.3  2127.4   113.1  2127.6   114.4  2127.6   121.3
GR2128.4   125.3  2128.4   125.8  2128.9   135.2  2129.6   137.1  2130.3   144.1
GR2130.5   144.3  2132.5   152.5  2133.3   154.9  2134.1   155.5  2134.4   156.3
GR2135.8   158.2  2136.6   160.1  2137.8   161.6  2138.6   163.9    2139   164.3
GR2139.7     166  2141.3   167.5  2141.7   168.1  2141.5   168.3  2151.7   169.1
GR2151.6   169.5  2153.4   171.5  2155.2     174  2180.9   213.3
HD65.042      10     5.2   166.0
```

CROSS SECTION #RM165.206

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.206      52      89   499.6     890     890     890
GR  2157     -90  2156.7   -29.6  2156.9       0  2154.7      42  2150.2      89
GR  2147   129.3  2146.3   147.7  2142.3   160.3  2141.7   163.1  2142.4   166.4
GR2142.7   172.8  2142.6   175.6  2142.6   177.7  2142.4   181.3  2141.8   198.1
GR2141.8   202.9  2141.7   205.2  2141.3   219.5    2141   227.4  2140.2   236.7
GR  2140   239.8    2140   243.9  2139.9   244.7  2139.7   250.2  2139.8   255.1
GR2140.1   259.8  2140.7   265.8  2141.1   267.2  2141.1   267.8  2141.3   271.3
GR2141.3   273.4  2141.4   274.4  2141.4   286.1  2141.3     290  2141.4   296.2
GR2141.4   298.6  2141.3   299.4  2141.3   309.2  2141.6   320.6  2141.5   324.3
GR2141.5     335  2141.6   335.5  2141.6   337.8  2141.9   343.5  2142.2   347.5
```

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GR2142.2   350.5  2142.5   362.8    2143   363.6  2146.3   385.9  2146.5   474.7
GR2149.6   499.6  2151.8   529.2
HD65.206      10   160.3   362.8
```

CROSS SECTION #RM165.325

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.325      71       0   1979.   668.7   668.7   668.7
GR  2155     -30  2150.2       0  2143.3      51  2143.2      51  2143.1      51
GR  2143    51.2  2142.9      52  2142.8    52.6  2141.7    56.7    2142    61.9
GR2141.7      64  2142.7    65.4  2142.6    66.1  2142.3      68  2143.1    72.2
GR2143.1    74.9  2142.8    77.1  2142.1    82.9  2141.6    87.6  2141.6    88.5
GR  2141    94.1  2140.5   101.8  2140.1   105.5  2139.9   110.4  2139.4   116.2
GR2138.9   120.6  2138.9     123  2138.8   125.3  2138.8   127.3  2138.4   130.7
GR2138.1   136.7  2138.1   138.9  2137.9   140.7  2137.9   146.5    2138   146.9
GR  2138   160.7  2137.9   162.4  2137.9   163.8  2137.4     174  2137.4   182.5
GR2137.5     183  2137.5   186.9  2138.2   194.7  2138.2   195.3  2140.9     210
GR2140.9   210.5  2141.1   210.8  2141.1   211.3  2141.8   213.5  2150.4   266.7
GR2154.9   273.3  2154.9   523.3    2150   543.3    2150   544.5    2150   553.8
GR  2150   571.6    2150   590.7    2150   623.4    2150   674.9    2150   736.9
GR  2150   823.9    2150   925.1    2150  1041.5    2150  1166.1    2150  1296.3
GR  2150  1434.3    2150  1578.8    2150  1736.1    2150    1909    2150    1979
GR  2155    2009
HD65.325      10    56.7   213.5
```

CROSS SECTION #RM165.428

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.428      70       0   1929.   583.6   583.6   583.6
GR  2152     -30    2147       0  2142.9     5.1  2142.7     5.8  2142.8     5.9
GR2141.2     9.1  2139.9     9.9  2139.4    10.4  2139.3    10.9  2136.9    13.4
GR2136.4    16.1  2136.4    18.8  2136.1      25    2136    33.1  2135.9    34.8
GR2135.9    37.9  2136.1    42.4  2136.1      53    2137      58  2136.9    58.7
GR  2138    72.1  2138.4    75.8  2139.1    89.6  2139.2      90  2138.8    91.5
GR2138.9    92.7  2139.4    94.3  2139.4    95.6  2139.6   101.5  2139.6   103.8
GR2139.8   104.7  2139.6   105.3  2140.1   109.9  2140.1   110.8  2140.3   111.2
GR  2140   117.9  2140.2   118.9  2140.2   122.2  2140.6   124.6  2140.7   124.8
GR  2141   126.3  2140.9   127.3  2141.6   130.4  2141.8   130.4  2142.1   131.5
GR2142.4   131.7  2142.6   131.7  2143.1   132.1  2143.3   132.7  2143.3   133.5
GR2146.9   139.4    2151     145    2151     500    2150   561.5    2150   573.8
GR  2150   591.6    2150   610.7    2150   643.4    2150   694.9    2150   756.9
GR  2150   843.9    2150   945.1    2150  1061.5    2150  1186.1    2150  1316.3
GR  2150  1454.3    2150  1598.8    2150  1756.1    2150    1929    2152    1959
HD65.428      10     5.1   132.7
```

CROSS SECTION #RM165.652

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.652      54       0   669.4  1265.6  1082.7  1265.6
GR  2152     -50  2149.4       0  2147.7    30.7  2145.9    39.1  2142.6      44
GR2143.7      46  2143.4    49.3  2144.1    50.9  2144.2    52.4  2143.9    53.4
GR2143.6    56.8  2143.6    57.6  2143.4    60.1  2142.2    65.2  2141.5      71
GR2141.3      79  2141.1    80.2    2141    82.9  2140.6    85.7  2140.6    88.6
GR2140.4    91.7  2139.8    95.2  2139.5    96.2  2139.7    96.4  2139.8    99.2
GR2139.8   107.8  2139.6   109.9  2139.9   115.5  2140.1   124.6  2140.4     126
GR2140.6   127.9  2140.6   128.6  2140.8   129.1  2140.8   131.2  2140.9     132
GR2140.9   135.8  2141.1   136.4  2141.1     137  2140.6   138.9  2140.6   140.1
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GR2141.5   147.4  2141.7   147.8  2142.2   150.2  2142.6   151.1  2142.7   152.3
GR2143.4   153.3  2143.9   156.2  2147.8   161.4  2148.9   166.1  2150.8   232.8
GR2151.1   308.5    2150   410.2    2150   669.4    2152   738.3
HD65.652      10    30.7   161.4
```

CROSS SECTION #RM165.685*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.685     112       6   742.3  190.67  190.67  190.67
GR2153.9   -33.3  2151.8       6  2149.9    35.9  2148.3    43.7  2148.1    48.7
GR2146.6    63.5  2146.6    64.8  2146.2    66.8  2145.6    71.2  2145.3    72.7
GR2143.1    77.2  2142.9    77.4  2143.6    79.1  2143.4    81.3  2143.3    82.1
GR2143.3    82.2  2143.8    83.7  2143.8    85.2  2143.5    86.1  2143.5      87
GR2143.3    88.8  2143.2    89.3  2143.2      90    2143    92.4  2142.1    97.2
GR2141.9    99.1  2141.6   102.1  2141.6   102.6  2141.5   104.3  2141.4   110.1
GR2141.4   110.2  2141.2   111.3  2141.2   113.8  2140.9     116  2140.9   119.2
GR2140.8   120.7  2140.8   122.1  2140.7   122.4  2140.3   125.4  2140.1   126.3
GR2140.2   126.5  2140.4   128.6  2140.4   135.2  2140.2   136.8  2140.5     141
GR2140.6   144.4  2140.6   146.3  2140.7   147.6  2140.7     148  2140.9   149.1
GR  2141   150.5    2141     151  2141.2   151.4  2141.2   156.5  2141.4     157
GR2141.4   157.5    2141   158.9    2141   159.8  2141.1   160.5  2141.3   161.8
GR2141.6   165.2  2141.7   165.4  2141.8   165.7    2142   166.2  2142.1   166.8
GR2142.5   168.2  2142.6   169.1  2143.1   169.9  2143.5   172.1  2146.3   176.1
GR2146.8   178.3  2147.1   179.7  2147.1   179.9  2147.4   186.2  2148.8   200.1
GR2149.4   206.7  2149.6   209.6  2151.6   230.6  2150.4   312.9  2149.3   335.1
GR  2146   423.6    2146   470.7  2148.1   538.5  2146.7   598.9  2146.5   615.8
GR2146.4   639.9  2146.5   663.1  2146.5   675.3  2146.6   689.1  2146.1   691.2
GR2145.7   693.5  2145.3   695.9  2145.2   698.8  2145.1     704  2145.1   705.5
GR2145.3   709.5  2145.5     715  2145.7   719.5  2145.9   724.3  2146.2   728.7
GR2146.4   732.4  2146.7     736  2146.9     739  2147.2   742.3  2147.6     747
GR2148.3   750.2  2148.6   751.6  2149.5   755.5  2151.3   762.5  2153.4   768.9
GR2154.2   776.1  2154.8   780.5
HD65.685      10    63.5   176.1
```

CROSS SECTION #RM165.719*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.719     116    71.9   795.7  190.67  190.67  190.67
GR2155.7   -16.7  2152.8    31.2  2150.4    71.9  2147.7    79.2  2147.5    83.8
GR2145.4    97.6  2145.5    98.4  2145.5    98.8  2145.2   100.8  2144.9   104.8
GR2144.7   106.2  2143.6   110.4  2143.3   110.5  2143.1   110.6  2143.4   112.3
GR2143.4   114.3  2143.3     115  2143.3   115.2  2143.4   116.2  2143.5   116.6
GR2143.4   117.9  2143.2   118.8  2143.1   119.3  2143.1   119.7    2143   121.3
GR2142.8   121.8  2142.8   122.5  2142.6   124.7    2142   129.2  2141.9   130.9
GR2141.7   133.7  2141.7   134.3  2141.6   135.8  2141.5   141.3  2141.5   141.4
GR2141.4   142.3  2141.4   143.2  2141.3   144.7  2141.2   146.7  2141.2   148.6
GR2141.1   149.5  2141.1   152.7  2140.8   155.5  2140.7   156.4  2140.8   156.5
GR2140.9     158  2141.1   160.6  2141.1   161.5  2140.9   162.5  2140.9   163.6
GR2141.1   166.6  2141.1   168.9  2141.2   170.2  2141.3   171.1  2141.3   171.4
GR2141.4   172.1  2141.5   173.1  2141.5   174.8  2141.6   175.3  2141.6   177.9
GR2141.5   178.9  2141.5   179.3  2141.4   179.4  2141.4     180  2141.6   180.9
GR2141.8   183.2  2141.8   183.4    2142   183.6  2142.1     184  2142.2   184.3
GR2142.3   184.9  2142.5   185.3  2142.6     186  2142.9   186.5  2143.2     188
GR2144.7   190.8  2145.1   192.3  2145.3   193.2  2145.4   193.4  2145.4   194.8
GR2145.7   197.8    2148   207.4    2149   211.9  2149.3   213.9  2152.5   228.4
GR2149.8   317.4  2148.6   341.4    2147     437    2147   487.9  2151.1   561.1
GR2148.4   626.5  2147.9   644.7  2147.7   670.8    2148   695.8  2148.2   723.9
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GR2147.3   726.2  2146.5   728.6  2145.6   731.2  2145.4   734.4  2145.3   740.1
GR2145.2   741.7  2145.3   745.9  2145.1   751.9  2145.1   761.9  2145.3   766.7
GR2145.5   774.6  2145.7   777.9  2145.9   781.4  2146.3   786.5  2147.4   789.9
GR  2148   791.4  2149.4   795.7  2152.2   803.3  2155.9   810.1  2156.7     818
GR2157.5   822.7
HD65.719      10    79.2   207.4
```

CROSS SECTION #RM165.753

```
NC .0401   .0401  .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.753      81   107.8    844.  190.67  190.67  190.67
GR2157.6       0  2150.9   107.8  2147.1   114.6  2146.9   118.9  2144.2   131.8
GR2144.4   132.5  2144.2   134.7  2144.2   138.5    2144   143.7  2143.3   143.9
GR2143.3   147.3  2143.2     148  2143.2   149.1  2142.7     152  2142.8   152.3
GR2142.6   153.8  2142.4   154.5  2141.8   162.8  2141.8   165.4  2141.6   167.3
GR2141.6   172.5  2141.5   174.2  2141.5   177.5  2141.5   179.2  2141.4   180.1
GR2141.4   181.6  2141.5   183.1  2141.3   186.5  2141.7   188.8  2141.7   189.3
GR2141.5   189.9  2141.7   193.4  2141.7   194.1  2141.9   194.6  2141.9   199.1
GR2141.8   199.2  2141.8   199.5  2141.9     200    2142     200  2141.9   201.3
GR2142.3   201.7  2142.3   201.9  2143.4   206.3  2143.6   206.9  2143.6   207.7
GR  2144   209.3  2147.2   214.6  2148.5   217.1  2148.9   218.2  2153.3   226.2
GR  2148   347.6    2148   505.1  2154.2   583.8  2150.1     654  2149.4   673.6
GR2149.1   701.6  2149.5   728.5  2149.6   742.7  2149.8   758.7  2148.4   761.2
GR2147.2   763.8  2145.9   766.6  2145.6     770  2145.4   776.1  2145.2   782.4
GR2144.7   788.8  2144.5   794.1  2144.3   799.6  2144.3   804.7  2144.3     809
GR2144.4   813.2  2144.5   816.7  2144.6   820.5    2145     826  2146.5   829.7
GR2147.3   831.3  2149.2   835.9  2153.2     844  2158.4   851.4  2159.3   859.8
GR2160.3   864.9
HD65.753      10   107.8   218.2
```

CROSS SECTION #RM165.892

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X165.892      53       0  1528.2   788.7   655.3   788.7
GR  2158     -50  2155.2   -26.6  2152.1       0  2151.6     3.3  2149.6    23.6
GR2147.6    26.7  2146.6    28.8    2145      35  2145.1    45.3  2145.4    55.6
GR2143.8    65.8  2143.8    76.1    2144    86.4  2145.4    96.7  2144.8   106.9
GR2148.8   118.6  2148.9   134.7  2151.4   142.7  2156.6   151.6  2157.7   157.2
GR2158.3   168.2    2155   198.2    2155   838.8    2151   863.8    2151  1169.9
GR2153.8  1194.9  2154.9  1223.1  2155.5  1248.1  2153.7  1261.4  2152.7  1294.1
GR2150.4  1303.8  2147.4  1308.1  2146.5  1311.1  2146.4  1315.5  2146.7  1320.6
GR2146.8  1326.4    2147  1331.4  2147.2  1336.7  2147.2    1343  2147.6  1348.8
GR2147.8  1355.3    2148  1362.9  2148.1  1368.8  2149.3  1373.4  2151.1  1380.9
GR2150.4  1397.9  2151.1  1410.3  2151.1  1440.6  2150.8  1462.7    2149  1477.5
GR2147.2  1488.8  2154.9  1528.2    2158  1538.8
HD65.892      10     3.3   142.7
```

CROSS SECTION #RM166.059

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.059      50       4  2309.1   837.5   773.7   837.5
GR  2163       0  2157.8       4  2147.7     7.8  2143.5    13.1  2142.4    16.4
GR2140.4    32.8  2142.1    49.2  2142.6    65.6  2144.9      82  2144.7    98.4
GR2145.4   114.8  2145.7   131.3  2147.4   147.7  2150.8   174.9  2152.1   186.6
GR2152.9   196.8  2155.9     199  2157.8   220.2  2155.5   250.2  2155.51204.452
GR  2153 1704.78    2153 1947.09  2153.8 1977.09  2154.9  2005.3  2155.5  2030.3
GR2153.7  2043.6  2152.7  2076.3  2150.4    2086  2147.4  2090.3  2146.5  2093.3
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GR2146.4  2097.7  2146.7  2102.8  2146.8  2108.6    2147  2113.6  2147.2  2118.9
GR2147.2  2125.1  2147.6    2131  2147.8  2137.5    2148  2145.1  2148.1    2151
GR2149.3  2155.6  2151.1  2163.1  2150.4  2180.1  2151.1  2192.5  2151.1  2222.8
GR2150.8  2244.9    2149  2259.7  2147.2    2271  2155.4  2309.1    2158    2321
HD66.059      10     7.8   131.3
```

CROSS SECTION #RM166.157*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.157     119       3  2320.6  634.82     475  634.82
GR  2163   -12.5  2157.9       3  2155.2       5  2153.5     5.9  2148.9      10
GR2145.5    19.8  2144.6      26  2144.2    31.3    2144    33.8  2144.1    33.9
GR  2144    35.8  2143.9    35.9  2143.9    36.6  2143.7    39.4  2143.7    40.1
GR2143.6    40.5  2143.6    40.7  2143.5    41.9  2143.5    43.2  2143.4    45.2
GR2143.4    45.5  2143.5    46.5  2143.4      47  2143.4    47.3  2143.3    49.8
GR2143.2    50.6  2143.1    52.5    2143    52.9  2143.1    52.9    2143    53.8
GR  2143      54  2142.9    55.3  2142.8    56.3  2142.8    56.8  2142.9      57
GR2142.9    57.8  2142.8    58.4  2142.9      59  2142.9    59.1  2142.8    59.1
GR2142.8    59.5  2143.1    61.5  2143.1      62  2143.2      64  2143.5    66.5
GR2144.5    73.1    2145    78.4  2145.2    86.8  2146.6    97.9    2147   100.5
GR2147.2   114.2  2148.2   127.8  2148.3   131.1  2148.6   141.6  2150.1   155.2
GR2152.9   177.9    2154   187.7  2154.8   196.2    2157     198  2158.7   215.7
GR  2157   241.4    2157  1060.7  2155.5  1390.2  2153.5  1490.3  2153.5  1769.5
GR2154.3  1793.8  2155.3  1816.7  2155.9    1837  2154.4  1850.1  2154.3  1851.6
GR  2154  1857.8  2153.4  1874.4  2153.3  1876.6    2153  1886.6  2152.9    1887
GR2152.9  1887.5  2151.6  1894.4  2150.9  1898.2  2148.3  1902.9  2148.3    1903
GR2147.5  1906.2  2147.4  1906.3  2147.3    1911  2147.6  1915.2  2147.6  1916.5
GR2147.7  1919.9  2147.7  1922.7  2147.8  1923.3  2147.8    1924  2147.9  1928.1
GR  2148  1928.3  2148.1  1933.4  2148.1  1934.8  2148.2  1938.1  2148.2  1940.4
GR2148.4  1943.4  2148.5  1944.7  2148.6  1946.7  2148.7  1949.5  2148.8  1953.6
GR2148.8  1954.3    2149    1958  2149.1  1959.6  2149.2  1961.8  2149.4  1964.1
GR2149.4  1968.1  2151.2  1977.9  2151.8    1981  2151.7  1987.9  2151.5  1999.2
GR2152.2  2012.5  2152.2  2089.4    2152  2145.5  2150.6  2183.1  2149.8  2199.7
GR2149.3  2211.8  2154.3  2290.9  2156.7  2320.6  2159.2  2338.7
HD66.157      10    10.0   155.2
```

CROSS SECTION #RM166.255*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.255     118       2  2310.6  634.83     475  634.83
GR  2163     -25    2158       2  2155.4     4.9  2153.3     6.2  2150.1    12.3
GR2147.6    26.6  2146.7    35.5  2146.3    43.3  2146.2      47  2146.2    49.9
GR2146.1      50  2146.1      51    2146    55.2  2145.8    56.2  2145.8      57
GR2145.7    58.8  2145.8    60.7  2145.7    63.6  2145.7    64.1  2145.9    65.5
GR2145.9    66.2  2145.8    66.7  2145.7    70.3  2145.6    71.4  2145.5    74.3
GR2145.5    76.1  2145.4    76.5  2145.3    78.4  2145.2    79.8  2145.2    80.7
GR2145.4    81.3  2145.4    82.8  2145.2      84  2145.4    85.2  2145.4    85.4
GR2145.2    85.5  2145.2    86.2  2145.5    87.7  2145.6    88.1  2145.5    89.7
GR2145.7    91.7    2147    97.1  2147.7   101.3  2147.8     108  2148.7   116.9
GR2149.1     119  2149.8   129.9  2150.9   140.8  2151.1   143.5  2151.5   151.9
GR2152.8   162.8  2155.1   180.9    2156   188.7  2156.6   195.5  2158.2     197
GR2159.6   211.1  2158.4   232.7  2158.4     917  2157.5  1192.2    2154  1275.8
GR  2154    1592  2154.8  1610.6  2155.7  1628.1  2156.4  1643.6    2155  1657.9
GR2154.8  1659.5  2154.8  1659.6  2153.7  1684.4  2153.6  1686.8  2153.2  1697.7
GR2153.2  1698.2  2153.1  1698.7    2152  1706.2  2151.4  1710.4  2149.2  1715.5
GR2149.1  1715.6  2149.1  1715.7  2148.4  1719.1  2148.4  1719.2  2148.2  1724.4
GR2148.5  1728.9  2148.6  1730.2  2148.6  1733.8  2148.7  1736.8  2148.7  1737.5
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GR2148.8  1738.2  2148.9  1742.5  2148.9  1742.7    2149  1748.2  2149.1  1748.6
GR2149.1  1749.7  2149.2  1753.3  2149.2  1755.6  2149.4  1758.9  2149.5  1760.3
GR2149.6  1762.4  2149.6  1765.4  2149.8  1769.8  2149.8  1770.5  2150.1  1774.4
GR2150.2  1776.1  2150.4  1778.5  2150.7  1780.9  2150.7  1785.2  2151.4  1790.4
GR2151.9  1795.6  2152.4    1799  2152.6  1806.3  2152.6  1818.4  2153.3  1832.5
GR2153.3    1956  2153.1  2046.1  2152.2  2106.5  2151.7  2133.1  2151.4  2152.5
GR2154.7  2279.6    2157  2310.6  2160.5  2356.4
HD66.255      10    12.3   140.8
```

CROSS SECTION #RM166.353*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.353     123       1  2310.6  634.83     475  634.83
GR  2163   -37.5    2158       1  2155.7     4.8  2153.2     6.6  2151.4    14.5
GR2149.6    33.3  2148.9    45.1  2148.4    55.3  2148.3    60.1  2148.4    60.3
GR2148.4    63.9  2148.3    64.1  2148.3    65.5  2148.2    65.5  2148.2    70.9
GR  2148    72.2    2148      73  2147.9    73.4  2147.9    75.7    2148    78.2
GR  2148      82  2147.9    82.3  2147.9    82.6  2148.3    84.5  2148.3    85.5
GR2148.2      86  2148.2    90.8    2148    92.3    2148    96.1  2147.9    96.1
GR2147.9    96.8    2148    96.8  2147.9    98.5  2147.8    98.9  2147.8   101.4
GR2147.6   103.4  2147.6   104.7  2147.9   105.6  2147.9   107.7  2147.7   109.6
GR2147.9   111.4  2147.9   111.7  2147.7   111.8  2147.6   112.2  2147.6   112.8
GR  2148     114    2148   114.3  2147.8   115.5    2148     117  2149.4     121
GR2150.4   124.2  2150.4   129.2  2150.8   135.9  2151.1   137.5  2152.3   145.7
GR2153.7   153.9    2154   155.8  2154.5   162.1  2155.4   170.3  2157.2     184
GR2157.9   189.8  2158.5   194.9  2159.3     196  2160.5   206.6  2159.9   223.9
GR2159.9   773.3  2159.4   994.2  2154.5  1061.3  2154.5  1414.4  2155.3  1427.4
GR2156.8  1450.2  2155.5  1465.8  2155.3  1467.5  2154.9  1474.9    2154  1494.5
GR2153.8  1497.1  2153.5  1508.9  2153.4  1509.3  2153.4    1510  2152.4  1518.1
GR2151.9  1522.6    2150  1528.1    2150  1528.3  2149.4    1532  2149.3  1532.1
GR2149.2  1537.8  2149.5  1542.5  2149.5  1543.9  2149.6  1547.8  2149.6  1550.9
GR2149.7  1551.6  2149.7  1552.4  2149.8    1557  2149.9  1557.2    2150    1563
GR  2150  1563.4  2150.1  1564.6  2150.2  1568.4  2150.3  1570.9  2150.4  1574.3
GR2150.5  1575.8  2150.6  1578.1  2150.6  1581.2  2150.7  1585.9  2150.7  1586.7
GR2151.2  1590.9  2151.4  1592.7  2151.7  1595.1    2152  1597.8    2152  1602.3
GR2152.4  1607.8  2152.7  1613.4  2153.1  1616.9  2153.4  1624.7  2153.7  1637.5
GR2154.4  1652.5  2154.4  1822.7  2154.3  1946.8  2153.9  2029.9  2153.4  2093.3
GR2155.1  2268.4  2157.8  2310.6  2161.8  2374.1
HD66.353      10    14.5   137.5
```

CROSS SECTION #RM166.451

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.451      97       0  2300.7  634.83     475  634.83
GR  2163     -50  2158.1       0  2155.9     4.7    2153     6.9  2150.5    67.3
GR2150.5    73.3  2150.6    73.5  2150.6      78  2150.5    78.2  2150.5    79.9
GR2150.4    79.9  2150.4    86.7  2150.2    88.3  2150.2    89.3  2150.1    89.7
GR2150.1    92.6  2150.3    95.7  2150.3   100.4  2150.2   100.8  2150.2   101.2
GR2150.7   103.5  2150.7   104.7  2150.6   105.4  2150.6   111.3  2150.4   113.2
GR2150.4   117.9  2150.3   117.9  2150.3   118.7  2150.4   118.7  2150.4   120.8
GR2150.2   121.4  2150.2   124.5    2150   126.9    2150   128.6  2150.4   129.8
GR2150.4   132.7  2150.1   135.2  2150.4   137.6  2150.4     138  2150.3     138
GR2150.1   138.2    2150   138.6    2150   139.5  2150.4   140.3  2150.4   140.5
GR2150.1   141.3  2150.2   142.3  2153.1   147.1  2152.9   154.9  2156.8   168.2
GR2161.4   202.1  2161.4   359.3  2161.4   796.2    2155   846.8    2155   949.8
GR  2155  1054.3    2155  1236.9  2157.2  1256.9  2156.1  1273.6  2155.9  1275.5
GR2155.4  1283.4  2154.3  1304.5  2154.1  1307.3  2153.7    1320  2153.6  1320.5
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GR2153.6  1321.2  2152.8  1329.9  2152.4  1334.8  2150.9  1340.8  2150.9  1340.9
GR2150.3    1345  2150.1  1351.1  2150.4  1356.1  2150.5  1361.7  2150.6  1365.8
GR2150.7  1366.6  2150.8  1371.7  2150.9  1377.8    2151  1379.5  2151.2  1383.5
GR2151.4  1389.8  2151.5  1391.4  2151.6  1397.1  2151.7  1402.1  2151.7  1402.9
GR2152.3  1407.3  2152.5  1409.2  2153.3  1414.6  2153.3  1419.4  2153.5  1431.1
GR2154.3  1443.1  2155.5  1472.5  2155.5  1540.3  2155.5    2000  2155.5  2257.1
GR2158.1  2300.7    2163  2391.8
HD66.451      10     6.9   154.9
```

CROSS SECTION #RM166.543*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.543     139       0  1273.9   601.5   601.5   601.5
GR  2163   -43.3  2160.9   -21.6    2158       0  2157.3      .6  2155.7     3.6
GR2153.6     5.2  2153.6     5.3  2152.9    11.1  2151.9    21.4  2151.9    22.8
GR2151.7    28.3  2151.7    30.8  2151.5    37.5  2150.7    41.1  2150.7    42.8
GR2150.6    44.5  2150.3    46.1  2149.8      51  2149.6    54.2  2149.6    55.7
GR2149.5    57.8  2149.4    58.1  2149.3    59.1  2149.3    59.2  2149.2    60.5
GR2149.1    65.7    2149    66.4  2148.9    66.9  2148.9    70.3    2149    71.4
GR  2149    76.1  2148.9    76.4  2148.9    76.7  2149.2    78.4  2149.2    79.3
GR2149.1    79.8  2149.1    84.3    2149    85.8    2149      87  2148.9    89.3
GR2148.8    89.9  2148.9    89.9  2148.9    91.5  2148.7      92  2148.6    94.3
GR2148.4    96.1  2148.4    97.3  2148.7    98.1  2148.7     100  2148.5   101.7
GR2148.7   103.3  2148.7   103.5  2148.5   103.7  2148.4   103.9  2148.4   104.5
GR2148.7   105.4  2148.8   105.6  2148.8   105.9  2148.6   106.9  2148.7   107.2
GR2148.7   108.3  2150.8   114.7  2150.8   114.8  2151.2   120.5  2151.4   123.9
GR2151.5   124.3  2151.6   125.2  2152.2   127.5  2152.4   128.3    2153   131.3
GR2153.2   132.1    2154   136.5  2154.1     137  2154.3   138.1  2155.1     143
GR2155.2   143.7  2155.4   147.3    2157   169.3  2157.2   172.7  2157.3     174
GR2157.4   174.5  2157.4   174.9  2158.7   180.4  2160.1   185.6  2160.8   187.8
GR2160.8   188.4  2160.7   649.6  2156.5   688.9  2156.4   768.9  2156.3   956.8
GR2156.2   991.8  2157.6  1007.3  2156.7  1019.5  2156.4  1024.3  2156.2  1026.3
GR2155.7  1034.3  2155.1  1045.5  2154.8    1049  2154.5  1055.8  2154.2  1064.7
GR2154.1  1065.4  2153.9  1071.6  2153.9  1072.9  2153.6    1077  2153.3  1081.7
GR2153.1  1086.7  2152.4  1090.6    2152  1092.8    2152  1092.9  2151.6  1097.1
GR2151.4  1103.3  2151.6  1108.3  2151.7  1113.8  2151.8  1117.8  2151.8  1117.9
GR2151.9  1118.7    2152  1123.7  2152.1  1129.8  2152.2  1131.4  2152.4  1135.4
GR2152.6  1141.6  2152.7  1143.2  2152.8  1148.9  2152.9  1153.8  2152.9  1154.6
GR2153.3  1158.9  2153.4  1160.8    2154  1166.2  2154.1  1170.9  2154.5  1182.5
GR2155.4  1194.4  2156.9  1223.5  2156.9  1273.9  2156.7  1302.2  2156.7  1964.6
GR2157.2  1976.3  2158.7  2005.8  2160.3  2031.6    2163  2091.9
HD66.543      10     5.2   136.5
```

CROSS SECTION #RM166.636*

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.636     137       0   974.4   601.5   601.5   601.5
GR  2163   -36.7  2157.8       0  2156.8      .4  2155.5     2.4  2154.2     3.6
GR  2153     7.6  2151.8    14.5  2151.8    15.5  2151.7    19.3  2151.8      21
GR2151.7    25.5  2150.3      28  2150.3    28.3  2150.4    29.1  2150.4    30.2
GR2149.9    31.4  2149.2    34.7  2148.8    36.8  2148.6    37.8  2148.6    37.9
GR2148.4    39.3  2148.1    39.5  2148.1    40.2    2148    40.3    2148    41.2
GR2147.7    44.7  2147.6    45.2  2147.6    46.2  2147.7    47.7  2147.7    47.8
GR2147.8    48.6  2147.8    49.3  2147.7    51.7  2147.6    51.9  2147.6    52.1
GR2147.7    53.3  2147.7    57.3  2147.6    58.3  2147.6    59.1  2147.4    60.7
GR2147.4    61.1  2147.3    62.2  2147.2    62.5  2147.1    64.1  2146.9    65.4
GR2146.9    65.9    2147    66.3    2147    67.3  2146.9    68.1    2147    68.9
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GR  2147    69.1  2146.9    69.1  2146.9    69.6  2147.2    70.6  2147.2    71.2
GR2147.1    72.6  2147.3    72.9  2147.2    74.1  2147.2    74.3  2148.5    82.3
GR2148.5    82.4  2149.3    89.5    2150    93.9  2150.2    94.4  2150.4    95.4
GR2151.1    98.3  2151.3    99.3  2151.8   103.2    2152   104.2  2152.6   109.6
GR2152.8   110.2  2152.8   111.6  2153.4   117.7  2153.5   118.6  2153.6   123.1
GR  2154   133.5  2154.5   150.7  2154.7     155  2154.7   156.7  2154.8   157.2
GR2154.8   157.7  2156.8   164.7  2159.2   171.1  2160.2     174  2160.3   174.6
GR2160.1     503  2159.3   513.7  2157.9     531  2157.8   587.9  2157.7   721.8
GR2157.3   746.6  2157.9   757.7  2156.9   770.2  2156.6     775  2156.5     777
GR2155.3   796.7    2155   800.2  2154.8   807.2  2154.6   810.1  2154.4   816.2
GR2154.3   816.9  2154.2   823.3  2154.1   823.8  2154.1   824.5  2153.9   828.8
GR2153.7   838.6  2153.4   842.6  2153.2   844.9  2153.2     845  2152.9   849.2
GR2152.6   855.6  2152.8   860.5    2153   865.9  2153.1   869.9  2153.1   870.7
GR2153.2   875.7  2153.3   881.7  2153.4   883.4  2153.6   887.3  2153.8   893.5
GR2153.9     895    2154   900.6  2154.1   905.5  2154.1   906.3  2154.3   910.6
GR2154.4   912.5  2154.8   917.7  2154.9   922.4  2155.6   933.9  2156.5   945.6
GR2158.4   974.4  2158.4  1021.9  2157.8  1048.5  2157.8  1672.1  2158.1  1683.2
GR2159.4  1710.9    2163  1791.9
HD66.636      10     3.6   156.7
```

###**MODEL TOTAL FLOW AT KINGSTON**###

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QT
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CROSS SECTION #RM166.729

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.729      73       0   725.4   601.5   601.5   601.5
GR  2163     -30  2157.7       0  2156.3      .2  2154.8     1.9  2153.2       4
GR2151.6     7.7  2151.7     8.2  2151.7    10.2  2151.9    11.1  2151.9    13.5
GR  2150    14.8    2150      15  2150.2    15.4  2150.2      16  2149.5    16.6
GR2147.9    19.5  2147.3    20.8  2146.9    20.9  2146.3    23.9  2146.5    25.3
GR2146.6    25.7  2146.2    28.4  2146.2    31.3  2145.3    34.6  2145.6    35.9
GR2145.6    38.2  2145.9    38.6  2145.7      40  2146.2      50  2147.5    58.6
GR2148.5    63.8  2148.8    64.4  2149.9    69.2  2150.1    70.4  2150.6      75
GR2150.8    76.2  2151.2    82.7  2151.4    83.5  2151.4    85.1  2151.8    93.6
GR2151.8      99    2152   111.4    2152   132.1  2152.1   137.3  2152.1   139.3
GR2152.2     140  2152.2   140.6  2154.9   148.9  2158.2   156.7  2159.6   160.1
GR2159.7   160.9  2159.4   362.8    2159   486.7  2158.3   508.1  2157.2   520.8
GR2155.5   547.8  2155.2   551.4  2154.7   567.7  2154.5   568.4  2154.3   580.5
GR2154.4   594.6  2153.9   607.8  2154.3     622  2154.6   635.3  2155.1   646.8
GR2155.3   657.2  2155.3   664.1  2155.7   673.9  2159.8   725.4  2159.8   769.9
GR  2159   794.9    2159    1390    2163    1492
HD66.729      10     4.0   148.9
```

CROSS SECTION #RM166.874

```
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X166.874      59    25.9   493.9   939.6   939.6   939.6
GR  2166       0  2161.9    25.9    2155    70.5    2154    75.5    2153   120.3
GR  2154   128.7    2155   133.7  2161.8   162.5  2161.9     256  2161.9   256.3
GR2157.6   260.4  2156.7   264.1  2154.1   290.9  2154.1   292.7  2153.9   299.5
GR2153.6   303.4  2153.7   304.8  2153.7   305.1  2153.1   315.8  2153.1   316.8
GR2152.1   339.4  2151.6   348.3  2151.6   358.3  2151.4     360  2151.4   366.8
GR2151.2     367  2150.8     380  2150.6   380.8  2150.6   383.1  2150.4   385.5
GR2150.5   387.2  2150.5   394.4  2150.6   395.8  2150.9   399.5  2151.2   400.5
GR2151.1   401.2  2150.9   408.4  2150.9   419.5  2151.1   430.2  2151.1   434.3
GR2151.2   434.5  2151.4     444  2151.6   450.3  2151.6   453.8  2151.7   455.5
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GR2151.7   459.8  2151.6   460.4  2151.6   462.1  2151.5   463.1  2151.3   468.9
GR2151.6   470.5  2151.6   472.8  2151.5     474  2152.4   474.8  2153.2   475.9
GR2154.1   479.2  2154.2   480.8  2161.3   493.9  2166.5   579.2
HD66.874      10   290.9   474.8

   CROSS SECTION #RM167.004
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X167.004      27   169.4   434.4   838.6   838.6   838.6
GR2159.4       0  2157.7    55.1  2156.8    63.1  2155.9      77  2155.7    93.4
GR2155.7     116  2155.8   124.8  2156.8   136.8  2158.8   146.3  2158.8   169.4
GR2158.4   178.4  2157.2   189.9  2157.5   194.4  2155.5   215.2  2154.4   242.2
GR2153.9   269.8  2152.5   293.4  2143.6     322  2141.1   328.4  2138.8     343
GR2140.7   359.4  2144.2   380.3  2151.6   399.9  2152.3   409.1  2155.5   413.3
GR  2162     430  2162.3   434.4
HD67.004      10   215.2   409.1

   CROSS SECTION #RM167.195
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X167.195      49    49.5   463.9  1057.8  1057.8  1057.8
GR2177.5       0  2174.1    40.7    2174    49.5  2158.6    55.1  2154.3    65.8
GR2154.6    70.1  2154.9    90.3  2155.1    94.4  2155.1   119.3  2154.9   127.2
GR2154.9   135.6  2154.8   138.5  2154.8   145.1  2154.9   145.7  2154.9     155
GR2154.8   157.2  2154.9   162.6  2154.8     164  2154.8   167.5  2155.4   175.1
GR2155.4   195.9  2155.6   197.4  2155.6   202.7  2155.5   203.7  2155.5   206.8
GR2155.6   209.7  2155.8   213.8  2155.8   217.1  2155.7   219.4  2155.7   231.7
GR2155.9   235.6  2155.9   238.3  2155.9   272.5    2156   279.5  2155.9     284
GR2155.9   287.3  2155.9   288.5    2156   291.6    2156   298.2  2155.9   300.7
GR2155.9   319.8    2156   321.3    2156   329.5  2155.9   331.6    2156   335.5
GR2155.9   343.3  2159.4   397.6  2159.3   419.9  2164.2   463.9
HD67.195      10    65.8   343.3

   CROSS SECTION #RM167.419
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X167.419      50     5.5   258.9  1247.7  1247.7  1247.7
GR2172.9       0  2167.3     5.5  2154.4    24.2  2154.2    24.7  2153.2    25.3
GR2153.1    25.8  2152.4    27.1  2152.4    27.7  2151.8    30.4  2151.9    33.1
GR2150.8      34  2150.7    34.4  2150.6    37.1  2150.4    37.3  2148.6    37.3
GR2148.1    38.7  2147.4    43.5  2147.5    43.7  2147.9    51.8  2148.2      54
GR2148.4    58.4  2148.8    61.1  2148.8      62    2149      66  2150.2    74.4
GR2150.4    75.9  2150.6    79.7  2151.1    85.3  2151.2    89.5  2151.6    93.3
GR2152.2   106.8  2152.2   109.7  2152.4   111.5  2152.4   112.2  2152.7   120.6
GR2152.9   130.4  2153.4   145.9  2155.1   174.1  2155.1   174.8  2155.5   184.1
GR2155.5   187.4  2155.5   192.3  2155.1   198.1  2154.4     201  2154.5   201.2
GR  2155   207.4  2153.6   208.5  2153.7   209.9  2164.3   258.9  2170.1   332.2
HD67.419      10    24.7   209.9

   CROSS SECTION #RM167.566
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X167.566      49      76   290.2   815.6   815.6   815.6
GR2185.1       0  2173.3      67    2165      76  2158.6    87.1  2156.8    91.8
GR  2154    93.9  2154.1    94.7  2154.1    96.1  2153.9    96.5  2152.7    97.4
GR2150.8     101  2150.7   101.8  2150.7     103  2150.4     104  2150.4   107.3
GR2150.2   107.7  2150.2   108.6  2149.5   109.8  2149.3   111.7  2148.8   112.3
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GR2148.9   113.1  2147.7   115.6  2147.9   117.9  2147.9   119.9  2146.9   120.7
GR2146.4   123.2  2146.2   125.2  2146.4   126.3  2146.5   127.2  2147.1   138.2
GR2148.2   149.1  2148.2   149.8  2149.2   155.9  2149.6   156.8  2149.7   159.7
GR  2151   168.5  2152.5   179.1  2152.8   182.6  2153.4   187.6  2153.7   188.6
GR2154.3   198.4  2154.6   198.9  2154.5   200.4  2154.6   204.7  2155.2   210.1
GR2158.7   247.3  2158.4   253.7  2166.3   290.2  2163.6   305.5
HD67.566      10    91.8   210.1

   CROSS SECTION #RM167.676
NC .0401   .0401   .0551
NV    24  -0.048    6440  -0.035   22000  -0.035   25500  -0.030   41000
X167.676      36   124.4   493.7   613.8   613.8   613.8
GR  2177       0  2165.8    14.9  2164.5    33.1  2164.4    45.9  2162.5    68.6
GR2161.3    74.7  2162.2    87.7  2162.4   106.8  2162.7   124.4  2160.7   127.8
GR2159.1   131.1  2160.2   167.2  2160.9   172.6  2160.9   172.8  2158.5   197.9
GR2157.7   211.5  2156.6   232.4  2156.3   253.3  2155.7   266.6  2155.6   285.6
GR2156.4   302.8  2157.7   336.1  2158.2   365.5  2158.8     400    2159   405.6
GR2157.8   419.3  2157.5   427.2  2158.1     442  2159.3   475.1  2160.3   477.7
GR2160.6   483.5  2162.6   487.6  2162.7   493.7  2163.5   498.9  2167.8   519.9
GR2169.5   539.9
HD67.676      10   127.8   477.7

   ###SOUTH FORK -- TRIBUTARY###
QT     2

   ***START OF NORTH FORK CHANNEL***

   CROSS SECTION #RM167.815
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
X167.815      52       0   210.5   770.5   770.5   770.5
GR  2169     -20  2164.1       0  2161.7     2.6  2157.5      14  2157.4    16.4
GR2156.4    26.5  2156.4      29  2156.2    31.3  2156.2    40.3  2155.9    42.8
GR2155.9    48.7  2155.9    56.8  2155.7    58.6  2155.3    71.4  2154.6    84.4
GR2153.3      95  2152.3   104.8  2152.3   106.4    2151   111.8    2150   115.3
GR2148.7   123.6  2148.6   124.6  2148.6   132.6  2149.5   140.8  2150.4   147.8
GR2149.8   157.6  2149.8   163.2  2149.9   164.3  2150.9   169.7  2151.7   174.4
GR2151.7   175.2  2152.1   176.6  2152.2   178.1  2152.2   179.9    2152   182.4
GR2151.8   183.8  2151.9   185.2  2152.5     189  2153.6   192.4  2154.1   194.7
GR2154.5   195.5  2155.2   197.7  2155.7   200.4  2156.4   201.2  2156.1   203.1
GR2156.1     204  2156.8   205.1    2157   205.2  2157.3   206.5  2157.2   206.6
GR2160.1   210.5    2169   220.5
HD67.815      10    14.0   206.5

   CROSS SECTION #RM168.003
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
X168.003      52    11.4   151.5    1041    1041    1041
GR  2170     -20  2167.3       0  2164.1     5.5  2166.5    11.4  2159.5    12.6
GR2157.4    14.2  2157.4    15.1  2155.6    17.2  2155.3    17.3  2153.6    18.6
GR2153.8    18.8  2153.5    21.1  2153.1    21.3  2153.1    21.8  2151.7    23.6
GR2151.1    24.6  2150.6    24.7  2149.1    28.4  2147.7    29.1  2147.7    30.3
GR2147.3    35.6  2147.7    40.3  2148.7    45.5  2148.6    46.1  2149.5    50.2
GR  2150      54  2150.2    54.8  2151.4    63.8  2151.7    65.1  2151.9    65.5
GR2152.2    69.8  2153.6    83.4  2153.8      84  2153.8    85.5  2154.4      95
GR2154.7    97.3  2154.7    99.8  2154.8     100  2155.3   103.5  2155.5   107.4
GR2155.8   108.5  2155.8   112.1  2156.3   115.5  2156.3   119.3  2156.6   122.5
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GR2156.8   122.7  2156.9   123.1  2156.9   125.2  2160.7   143.6    2163   147.8
GR2165.8   151.5    2170   171.8
HD68.003      10    14.2   125.2
```

CROSS SECTION #RM168.173

```
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
X168.173      50       0   243.5   867.3   867.3   867.3
GR2170.4       0  2161.2    59.6  2159.7   111.3  2157.3   146.2  2157.3   146.8
GR2157.2   146.9  2157.2   154.6  2156.8   158.3  2156.8   159.5  2156.9     160
GR2156.9   161.5  2156.8   161.6  2156.8     167  2156.6   167.7  2156.6     168
GR2156.7   169.1  2156.7   171.8  2156.6     172  2156.6   177.7  2156.4   179.9
GR2156.4     184  2156.1   184.2  2156.1   185.2    2156   186.3  2156.1   188.6
GR2155.7   191.6  2155.4   197.1  2154.9     199  2154.9   200.1  2154.8   200.7
GR2154.1   207.1  2153.9   207.8  2153.9   209.4    2154   209.7  2153.7   211.3
GR2155.4   213.7  2155.5   214.1  2155.3   214.4  2155.3   217.1  2155.1   220.3
GR2155.1   222.2  2154.7   225.1  2155.1     232  2155.4   232.1  2157.2   232.2
GR2158.1   232.9  2159.7     237  2167.8   243.5    2188   322.7  2201.7   334.7
HD68.173      10   111.3   232.1
```

CROSS SECTION #RM168.427

```
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
X168.427      51       0   255.3  1298.3  1298.3  1298.3
GR  2172     -20  2169.1       0  2163.5     5.2  2161.7       6  2156.4    13.8
GR2156.4    13.9  2155.9    15.1  2155.4    15.2  2154.8    17.8  2154.6    17.9
GR2152.2    29.2  2150.1    37.9    2150    39.2  2147.8    47.6  2147.7    50.1
GR2146.5    55.4  2146.2    55.7  2145.9    55.8  2143.8      60  2143.4    61.7
GR2142.4    64.8  2141.9    66.2  2138.8    72.6  2138.8    72.8  2136.7    78.4
GR2136.6      80  2135.5    83.8  2134.4    90.6  2134.4      91  2134.8    92.7
GR2136.1    97.9  2135.8      98  2136.7     100  2139.9   110.4  2141.3   115.1
GR2142.6   118.8  2144.4   123.3  2146.9   130.1  2147.5     132  2147.8   132.5
GR2149.4   136.2  2151.3   142.1  2153.4   147.7  2153.7   148.8  2154.3   150.5
GR2154.6   152.3  2157.4   160.3  2158.4     162  2158.5     162  2161.6   181.4
GR2172.1   255.3
HD68.427      10    17.9   147.7
```

CROSS SECTION #RM168.519

```
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
X168.519      51       5   151.8   471.4   471.4   471.4
GR  2175    -105  2166.5       0  2165.7       5  2161.9    16.3  2161.9      21
GR2158.1    37.5  2158.9    45.6  2158.9    46.6  2158.7    49.3  2158.6    49.3
GR2158.6    49.6  2158.6    50.5  2158.4    50.6  2157.7    57.4  2157.3    59.6
GR2157.1    59.9  2157.1    61.4    2157    61.4  2156.9    61.5  2156.6    62.4
GR2156.2    65.4  2156.2    66.1  2155.6    69.8  2155.4    70.3  2155.4      71
GR2155.3    71.1  2155.3    72.3    2155    72.5  2154.7    74.2  2154.4    74.4
GR2154.2    75.9  2153.8    77.2  2153.9    77.7  2153.6    78.6  2153.3    79.9
GR2153.4    81.9  2152.9    84.3  2152.9    85.3  2152.6    86.5  2152.4    86.6
GR2152.5      88  2152.3    88.5    2152      93  2152.1    93.5  2151.8    95.2
GR2151.4    98.6  2151.4    99.6  2161.9   148.2  2163.8   151.8  2170.1   158.8
GR2177.7   169.4
HD68.519      10    37.5   148.2
```

CROSS SECTION #RM168.713   ENAVILLE GAGING STATION

```
NC .0451   .0451   .0621
NV    24  -0.050    4130  -0.039   16700  -0.039   19400  -0.034   29500
```

```
X168.713      51   104.3   258.2     989     989     989
GR2179.7       0  2172.3    92.4  2167.9    98.6    2163   104.3  2156.6   158.5
GR  2156   166.1  2155.6   172.3  2155.6   184.5  2155.7   184.8  2155.7   186.7
GR2155.8   187.1  2155.8   189.2  2155.9   189.5    2156     191  2156.2   191.3
GR2156.1   192.1  2156.3   193.2  2156.3   194.2  2156.8   199.4  2157.2   203.1
GR2157.1   203.6  2157.1   204.3  2157.3   206.4  2157.3     207  2157.6   209.3
GR2157.6   210.4  2158.3   215.6  2158.3   216.5  2158.7   216.6  2158.7   218.2
GR2158.6   218.9  2158.6   220.8  2158.8   221.6  2159.5   228.1  2159.5   228.8
GR2159.7   229.4  2159.6   229.9  2159.8   230.2  2159.7   230.9  2159.7   231.4
GR2159.8   231.7  2159.7   231.9    2160   233.3    2160   235.7  2160.1   235.8
GR2163.4   252.3  2163.9   258.2  2165.8   273.6  2169.7   296.8  2167.9   301.2
GR  2175   401.2
HD68.713      10   104.3   252.3
EJ
$TRIB             ***Start of South Fork Geometry, Segment 2, Control Point 2***
CP     2
T1      CDA model--Continued.
T2      Fixed bed
T3      South Fork segment

  CROSS SECTION #RM0.150
NC .0451  .04541   .0411      .1      .3
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 0.150      29   666.1   791.6       0       0       0
GR  2169       0  2166.8      18  2166.4     278  2165.8   372.7  2164.5   510.3
GR2164.2   666.1    2163   688.3  2163.3   707.4  2163.3     723  2163.2   725.8
GR2160.3   728.3  2159.3   729.2  2157.6     733  2156.5   737.9  2156.2   743.7
GR  2156   747.5    2156     752    2156   755.8  2156.2   759.9  2155.9   763.9
GR  2156   767.8  2156.1   771.4  2156.5   774.8  2157.3     778  2158.1   781.2
GR2159.3   782.7  2162.5   783.3  2164.9   791.6  2168.3   798.9
HD 0.150      10   688.3   783.3

   CROSS SECTION #RM0.274
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 0.274      23       0   159.8   619.5   619.5   619.5
GR2169.5       0  2168.5    14.4  2166.3      29    2162    33.9  2161.3    34.5
GR2161.1    35.6  2159.4    37.6  2159.5    42.6  2159.5      47    2160    52.7
GR2160.2    59.7  2159.9    65.8  2159.5    73.3  2159.4    78.6  2159.4    85.8
GR2159.8    92.8  2160.5   100.2    2161   107.9  2161.5   115.8  2160.4   124.1
GR2164.7   135.1  2168.5     146  2169.8   159.8
HD 0.274      10    37.6   124.1

   CROSS SECTION #RM0.416
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 0.416      31    19.9   178.2   705.5   705.5   705.5
GR  2173    -438    2169    -428  2168.8       0  2168.8    19.9  2165.7    33.2
GR2165.6    52.8  2165.1    73.1    2163    85.2  2162.2    85.8  2160.8    89.4
GR2159.6    94.8  2158.9    98.3  2158.3   101.8  2158.3   105.4  2158.5   109.4
GR2158.8   114.4    2159   118.4  2158.9   124.8  2158.9   131.3  2158.7   136.8
GR2158.9   141.9  2158.9   148.1  2159.1   152.1  2160.3   154.5  2162.3   157.2
GR2162.6   157.7  2164.7   158.3  2165.8   161.6  2168.8   178.2    2169   278.2
GR2173.5   305.2
HD 0.416      10    85.8   157.2

   CROSS SECTION #RM0.592
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```
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 0.592      30    42.5   138.7     670   875.9   875.9
GR  2174    -215  2168.5    -195  2168.3       0    2168      11  2165.9    23.5
GR2165.7    38.5  2167.9    42.5  2167.1      59  2165.9    69.1  2163.3    69.3
GR2162.3    71.4  2161.4    73.1  2161.3    75.9  2160.9    80.7  2160.8    85.9
GR2160.7      91  2160.7    96.2    2161   100.7    2161   106.1  2160.9   110.7
GR2160.8   114.7  2160.8   118.8  2160.7   122.3  2160.6   125.2  2161.4   128.1
GR2163.2   130.7  2166.6   131.5  2168.6   138.7  2171.1   143.7  2174.1   149.5
HD 0.592      10    69.3   130.7
```

CROSS SECTION #RM0.915

```
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 0.915      35      36   174.7  1612.3  1612.3  1612.3
GR  2175     -65  2170.5   -25.5  2170.2       0  2170.5     8.3  2170.3    20.8
GR2170.6    29.5  2170.9      36  2168.6    42.9    2168      44  2166.9    47.3
GR2166.5    54.2  2166.1    60.6  2165.8    68.3  2165.6      78  2165.4    87.7
GR2165.5      98  2165.8   106.8  2166.2   118.1  2166.7   128.6  2166.9   136.5
GR2167.8   139.3  2167.7   142.6  2169.5     153  2169.5   154.5  2170.2   163.4
GR2170.6   174.7  2170.4   189.2  2169.3     207  2170.7   218.3  2170.3   248.6
GR2164.7   277.7  2171.2   336.1  2169.1   372.6  2171.1   388.2  2174.5   408.2
HD 0.915      10    44.0   139.3
```

CROSS SECTION #RM1.080

```
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 1.080      33    33.5   213.3   822.5     710   822.5
GR2175.6       0  2174.4    13.1  2173.4    33.5  2171.1      41  2169.6    44.6
GR2168.3    45.4  2167.1    46.5  2166.3    50.9  2165.5    54.3  2165.1    58.1
GR2164.7      63  2164.7    67.1  2164.9    71.3  2165.6    76.9  2165.9    81.7
GR2166.3    87.3  2166.5    94.3  2167.3   103.3  2167.9   111.2  2167.8   123.3
GR2168.3   130.2  2168.9     133  2169.9   144.8  2169.1   154.3  2170.1   166.4
GR2171.7     181  2172.6   197.8  2172.8   213.3  2172.7     233  2172.2   250.9
GR2171.9   268.9  2170.2   275.7  2175.7   286.8
HD 1.080      10    45.4   154.3
```

CROSS SECTION #RM1.282

```
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 1.282      30     -20   175.7  1005.4  1005.4  1005.4
GR2176.5     -50    2175     -20  2172.4       0  2171.2     6.8    2170     7.7
GR2167.8    13.5  2166.9    19.1  2166.6    21.4  2166.6    25.5  2166.6    30.2
GR2166.6    35.4  2166.8    40.5    2167    45.8  2166.6    50.7  2166.7    56.2
GR  2167      62  2167.2    66.1  2167.4    71.3  2167.5    75.8  2167.7    79.8
GR2169.9    80.9  2164.7      85  2173.1    85.4    2174    96.8  2174.2   110.2
GR2174.1   127.1  2173.8   148.3  2174.2   175.7    2175   383.7  2176.5   531.3
HD 1.282      10     7.7    80.9
```

CROSS SECTION #RM1.469

```
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 1.469      32     -85   307.9   933.8     600   933.8
GR  2178    -136    2177     -85  2176.2       0  2176.7    18.3  2175.1    37.6
GR2173.9    41.7  2173.2    49.6  2171.8    49.9  2171.2    52.6  2169.8    56.8
GR2169.4    60.3  2169.3    65.4  2169.2    70.5    2169    75.6  2168.9    80.8
GR2169.1    84.8  2169.6    90.6  2169.4    95.1  2169.1    98.9  2168.9   103.2
```

```
GR2169.2     107  2169.4   111.8  2169.5   116.4  2171.2   125.4  2172.2   134.3
GR2175.5   147.1  2175.5     180  2175.5   219.8  2176.7   261.4  2177.5   307.9
GR2177.7   350.9  2178.2   645.9
HD 1.469      10    49.9   134.3

   CROSS SECTION #RM1.580     PINEHURST GAGING STATION
NC .0451  .04541   .0411
NV    24  -0.041    1300  -0.025    3850  -0.039    4610  -0.034    5500
X1 1.580      35      70     311   554.4   554.4   554.4
GR2186.9       0  2182.7       8  2180.6      13  2178.1      18  2178.4      70
GR2177.5     101    2177     111  2177.2     121  2176.9     131  2175.9     141
GR2174.7     151  2175.3     161  2174.8     171  2173.1     181  2174.2     191
GR2173.4     196  2171.9     201  2171.1     211    2171     221  2171.3     231
GR2171.8     241  2171.2     251  2171.4     261  2171.7     271  2172.6     281
GR2172.4     291  2164.7     298  2173.2     301  2175.9     304  2177.5     311
GR2178.7     321  2180.4     331  2181.4     341  2182.7     345    2183     346
HD 1.580      10   196.0   301.0

   End of Model Geometry Data

EJ
T4       Main Stem Coeur d'Alene River including the North Fork
T5       Load curve from sediment-rating curve at Enaville (12413000)
T6       Bed Gradations from field samples
T7       Use full range of silt, sands, and gravels
T8       SEDIMENT TRANSPORT by Ackers & White (1973) transport function
I1     0       7
I2  CLAY       2
I2  CLAY       1
I2  CLAY       2
I3  SILT       2       1       4
I4  CDAR       7       1      13
I5            .5      .5     .25      .5     .25       0     1.0
LQ          4130   10238   16700   19400   29500
LT TOTAL    44.1  752.35  3650.5    5974   24282
LF  CLAY   0.000   0.000   0.000   0.000   0.000
LF SILT1   0.031   0.033   0.033   0.033   0.031
LF SILT2   0.102   0.111   0.110   0.109   0.103
LF SILT3   0.183   0.198   0.196   0.194   0.184
LF SILT4   0.257   0.279   0.277   0.274   0.259
LF   VFS   0.368   0.267   0.264   0.265   0.288
LF    FS   0.055   0.047   0.048   0.049   0.053
LF    MS   0.004   0.047   0.038   0.039   0.042
LF    CS   0.000   0.018   0.027   0.028   0.030
LF   VCS   0.000   0.000   0.006   0.009   0.010
LF   VFG   0.000   0.000   0.000   0.000   0.000
LF    FG   0.000   0.000   0.000   0.000   0.000
LF    MG   0.000   0.000   0.000   0.000   0.000
LF    CG   0.000   0.000   0.000   0.000   0.000
LF   VCG   0.000   0.000   0.000   0.000   0.000
LF    SC   0.000   0.000   0.000   0.000   0.000
LF    LC   0.000   0.000   0.000   0.000   0.000
LF    SB   0.000   0.000   0.000   0.000   0.000
PF MAINS  34.636     1.0     2.0     1.0    66.7     0.5    28.6    0.25    14.3
PFC0.125     4.8  0.0625     2.0   0.016     0.0
PF MAINS  55.739     1.0     8.0     8.0   100.0    4.75    99.9    2.36    99.8
PFC  2.0    99.8    1.18    99.8    0.85    99.8     0.6    99.7   0.425    88.6
```

```
PFC 0.25    23.8   0.106     0.7   0.075    0.28   0.016     0.0
PF MAINS  56.213     1.0     2.0     2.0   100.0    1.18    99.9    0.85    99.8
PFC  0.6    98.1   0.425    65.8    0.25    10.2   0.106    0.32   0.075    0.15
PFC0.016     0.0
PF MAINS  56.686     1.0     8.0     8.0   100.0    4.75    99.8    2.36    99.1
PFC  2.0    98.4    1.18    90.5    0.85    76.1     0.6    52.1   0.425    23.8
PFC 0.25     5.2   0.106    0.25   0.075    0.13   0.016     0.0
PF MAINS  57.067     1.0     8.0     8.0   100.0    4.75    99.8    2.36    98.7
PFC  2.0    98.3    1.18    94.7    0.85    93.3     0.6    86.2   0.425    52.9
PFC 0.25     5.4   0.106    0.16   0.075    0.10   0.016     0.0
PR MAINS  59.733     1.0     8.0     1.0    66.7     0.5    28.6    0.25    14.3
PFC0.125     4.8  0.0625     1.0   0.016     0.0
PF MAINS  59.821     1.0   256.0    64.0    98.6    45.0    90.1    32.0    67.6
PFC 22.5    49.3    16.0    34.5    11.0    18.3     8.0     9.9     5.6     3.5
PFC  4.0     0.0  0.0625     0.0
PF MAINS  64.777     1.0   256.0    64.0    98.6    45.0    90.1    32.0    67.6
PFC 22.5    49.3    16.0    34.5    11.0    18.3     8.0     9.9     5.6     3.5
PFC  4.0     0.0  0.0625     0.0
PF MAINS  66.255     1.0   256.0    90.0    97.4    64.0    80.5    45.0    61.1
PFC 32.0    40.7    22.5    17.7    16.0     7.1    11.0     3.5     8.0     0.0
PFC  4.0     0.0  0.0625     0.0
PF MAINS  67.004     1.0   256.0   128.0    98.9    90.0    94.6    64.0    79.4
PFC 45.0    54.4    32.0    34.8    22.5    15.2    16.0     6.5    11.0     2.2
PFC  8.0     1.1     5.6     1.1     4.0     0.0  0.0625     0.0
PF MAINS  68.173     1.0   256.0   128.0    95.3    90.0    83.2    64.0    60.8
PFC 45.0    39.3    32.0    20.6    22.5     8.4    16.0     5.6    11.0     1.9
PFC  8.0     0.0     5.6     0.0     4.0     0.0  0.0625     0.0
PF MAINS  68.713     1.0   256.0   128.0    95.3    90.0    83.2    64.0    60.8
PFC 45.0    39.3    32.0    20.6    22.5     8.4    16.0     5.6    11.0     1.9
PFC  8.0     0.0     5.6     0.0     4.0     0.0  0.0625     0.0
$LOCAL
LQL          890    1010    2250    2493    6000
LTLTOTAL    0.89    1.28    13.9    19.0   279.8
LFL CLAY   0.000   0.000   0.000   0.000   0.000
LFLSILT1   0.021   0.022   0.027   0.028   0.032
LFLSILT2   0.073   0.076   0.092   0.094   0.107
LFLSILT3   0.132   0.136   0.165   0.168   0.192
LFLSILT4   0.186   0.192   0.231   0.236   0.269
LFL  VFS   0.588   0.557   0.342   0.334   0.282
LFL   FS   0.000   0.017   0.069   0.067   0.056
LFL   MS   0.000   0.000   0.062   0.061   0.050
LFL   CS   0.000   0.000   0.012   0.012   0.010
LFL  VCS   0.000   0.000   0.000   0.000   0.002
LFL  VFG   0.000   0.000   0.000   0.000   0.000
LFL   FG   0.000   0.000   0.000   0.000   0.000
LFL   MG   0.000   0.000   0.000   0.000   0.000
LFL   CG   0.000   0.000   0.000   0.000   0.000
LFL  VCG   0.000   0.000   0.000   0.000   0.000
LFL   SC   0.000   0.000   0.000   0.000   0.000
LFL   LC   0.000   0.000   0.000   0.000   0.000
LFL   SB   0.000   0.000   0.000   0.000   0.000
$TRIB
T4       South Fork Coeur d'Alene River
T5       Load curve from sediment-rating curve at Pinehurst (12413470)
T6       Bed Gradations from field samples
T7       Use full range of silts, sands, and gravels
T8       SEDIMENT TRANSPORT by Ackers & White (1973) transport function
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LQL          1300    2469    3850    4610    5500
LTLTOTAL     39.0   308.9    1325    2402    4313
LFL CLAY    0.000   0.000   0.000   0.000   0.000
LFLSILT1    0.119   0.134   0.142   0.145   0.147
LFLSILT2    0.096   0.109   0.116   0.118   0.120
LFLSILT3    0.079   0.089   0.094   0.096   0.098
LFLSILT4    0.067   0.075   0.080   0.082   0.083
LFL  VFS    0.530   0.394   0.377   0.371   0.365
LFL   FS    0.109   0.101   0.097   0.095   0.094
LFL   MS    0.000   0.098   0.079   0.078   0.077
LFL   CS    0.000   0.000   0.015   0.015   0.015
LFL  VCS    0.000   0.000   0.000   0.000   0.001
LFL  VFG    0.000   0.000   0.000   0.000   0.000
LFL   FG    0.000   0.000   0.000   0.000   0.000
LFL   MG    0.000   0.000   0.000   0.000   0.000
LFL   CG    0.000   0.000   0.000   0.000   0.000
LFL  VCG    0.000   0.000   0.000   0.000   0.000
LFL   SC    0.000   0.000   0.000   0.000   0.000
LFL   LC    0.000   0.000   0.000   0.000   0.000
LFL   SB    0.000   0.000   0.000   0.000   0.000
PF SFCDA    0.150     1.0   256.0    64.0    99.0    45.0    81.7    32.0    71.2
PFC 22.5     57.7    16.0    43.3    11.0    30.8     8.0    19.2     5.6    10.6
PFC  4.0      3.9     2.0     0.0  0.0625     0.0
$HYD
*   AB     Day    0.10, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
T    10.     10.     10.
W   0.10
*   AB     Day    0.20, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.30, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.40, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.50, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.60, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.70, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    0.80, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
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```
*   AB     Day    0.90, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    1.00, A/B Level Output
Q  4560.    220.    600.
R 2125.8  2163.9
W   0.10
*   AB     Day    1.10, A/B Level Output
Q  3440.    121.    489.
R 2125.8  2162.9
W   0.10
*   AB     Day    1.20, A/B Level Output
Q  3440.    121.    489.
R 2125.8  2162.9
W   0.10
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*   AB     Day  364.60, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  364.70, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  364.80, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  364.90, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.00, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.10, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
```

Dots represent a similar continuation of the time series from Day 1.20 through Day 364.60.

```
W   0.10
*   AB     Day  365.20, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.30, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.40, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.50, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.60, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.70, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.80, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
*   AB     Day  365.90, A/B Level Output
Q  1440.    -23.    273.
R 2125.1  2160.0
W   0.10
$$END
```

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Appendix D. Grain Shear Stress, Largest Mobilized Particle, and Particle Classification for FASTMECH simulations 1 through 5, Coeur d'Alene River, Idaho

Table D-1. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for FASTMECH simulation 1 (river discharge, 10,500 cubic feet per second), in the Dudley reach, Coeur d'Alene River, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)]

Model simulated results Average τ_b = 1.8 N/m^2 Maximum τ_b = 2.1 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 1.2 N/m^2 d_a = 1.9 mm Very coarse sand	τ'_o = 1.4 N/m^2 d_a = 2.2 mm Very fine gravel	τ'_o = 1.5 N/m^2 d_a = 2.4 mm Very fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 0.80 N/m^2 d_a = 1.4 mm Very coarse sand	τ'_o = 1.1 N/m^2 d_a = 1.8 mm Very coarse sand	τ'_o = 1.3 N/m^2 d_a = 2.0 mm Very fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 0.58 N/m^2 d_a = 1.1 mm Very coarse sand	τ'_o = 0.88 N/m^2 d_a = 1.5 mm Very coarse sand	τ'_o = 1.1 N/m^2 d_a = 1.7 mm Very coarse sand

Table D-2. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for FASTMECH simulation 2 (river discharge, 14,000 cubic feet per second), in the Dudley reach Coeur d'Alene River, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)]

Model simulated results Average τ_b = 2.2 N/m^2 Maximum τ_b = 2.6 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 1.4 N/m^2 d_a = 2.3 mm Very fine gravel	τ'_o = 1.7 N/m^2 d_a = 2.7 mm Very fine gravel	τ'_o = 1.9 N/m^2 d_a = 2.8 mm Very fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 0.97 N/m^2 d_a = 1.6 mm Very coarse sand	τ'_o = 1.4 N/m^2 d_a = 2.1 mm Very fine gravel	τ'_o = 1.6 N/m^2 d_a = 2.4 mm Very fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 0.71 N/m^2 d_a = 1.3 mm Very coarse sand	τ'_o = 1.1 N/m^2 d_a = 1.8 mm Very coarse sand	τ'_o = 1.3 N/m^2 d_a = 2.0 mm Very fine gravel

Table D-3. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for FASTMECH simulation 3 (river discharge, 17,300 cubic feet per second), in the Dudley reach Coeur d'Alene River, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)]

Model simulated results Average τ_b = 2.7 N/m^2 Maximum τ_b = 3.3 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 1.8 N/m^2 d_a = 2.7 mm Very fine gravel	τ'_o = 2.1 N/m^2 d_a = 3.2 mm Very fine gravel	τ'_o = 2.3 N/m^2 d_a = 3.4 mm Very fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 1.2 N/m^2 d_a = 1.9 mm Very coarse sand	τ'_o = 1.7 N/m^2 d_a = 2.5 mm Very fine gravel	τ'_o = 1.9 N/m^2 d_a = 2.9 mm Very fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 0.87 N/m^2 d_a = 1.5 mm Very coarse sand	τ'_o = 1.3 N/m^2 d_a = 2.1 mm Very fine gravel	τ'_o = 1.6 N/m^2 d_a = 2.4 mm Very fine gravel

Table D-4. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for FASTMECH simulation 4 (river discharge, 22,860 cubic feet per second), in the Dudley reach Coeur d'Alene River, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)

Model simulated results Average τ_b = 4.0 N/m^2 Maximum τ_b = 4.9 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 2.6 N/m^2 d_a = 3.9 mm Very fine gravel	τ'_o = 3.23 N/m^2 d_a = 4.6 mm Fine gravel	τ'_o = 3.4 N/m^2 d_a = 4.9 mm Fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 1.8 N/m^2 d_a = 2.7 mm Very fine gravel	τ'_o = 2.5 N/m^2 d_a = 3.6 mm Very fine gravel	τ'_o = 2.8 N/m^2 d_a = 4.1 mm Fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 1.3 N/m^2 d_a = 2.0 mm Very fine gravel	τ'_o = 2.0 N/m^2 d_a = 3.0 mm Very fine gravel	τ'_o = 2.4 N/m^2 d_a = 3.5 mm Very fine gravel

Table D-5. Grain shear stress, largest mobilized particle, and particle classification for a factor of 0.5, 1.0, and 1.5 times the dune height and (or) dune length for FASTMECH simulation 5 (river discharge, 28,900 cubic feet per second), in the Dudley reach Coeur d'Alene River, Idaho.

[**Abbreviations:** d_a, largest mobilized particle size in millimeters; N/m^2, Newtons per square meter; ft, feet; mm, millimeter. **Symbols:** λ, wave length of dune, in feet; Δ, wave height of dune in feet; τ_b, FASTMECH simulated bed shear stress, in Newtons per square meter (see equation 3); τ'_o, grain shear stress, in Newtons per square meter (see equation 5)]

Model simulated results Average τ_b = 5.7 N/m^2 Maximum τ_b = 6.7 N/m^2		Wave length (λ) multiplication factor		
		0.5 (λ = 31.5 ft)	1.0 (λ = 63 ft)	1.5 (λ = 94.5 ft)
Wave height (Δ) multiplication factor	0.5 (Δ = 0.55 ft)	τ'_o = 3.7 N/m^2 d_a = 5.3 mm Fine gravel	τ'_o = 4.5 N/m^2 d_a = 6.4 mm Fine gravel	τ'_o = 4.9 N/m^2 d_a = 6.9 mm Fine gravel
	1.0 (Δ = 1.1 ft)	τ'_o = 2.5 N/m^2 d_a = 3.0 mm Very fine gravel	τ'_o = 3.5 N/m^2 d_a = 5.1 mm Fine gravel	τ'_o = 4.0 N/m^2 d_a = 5.7 mm Fine gravel
	1.5 (Δ = 1.65 ft)	τ'_o = 1.8 N/m^2 d_a = 2.8 mm Very fine gravel	τ'_o = 2.8 N/m^2 d_a = 4.1 mm Fine gravel	τ'_o = 3.4 N/m^2 d_a = 4.9 mm Fine gravel

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