Airtanker Drop Guides

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Ground Pattern Performance of the California Department of Forestry Bell S205 Helicopter With the 300-Gallon Sims Rainmaker Collapsible Helibucket

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The Wildland Fire Chemical Systems (WFCS) Program tests a variety of fixed- and rotary-wing airtankers to determine the parameters for optimal ground-pattern coverage over a wide range of fuel and fire conditions. The CDF Bell S205 helicopter (operated by the California Department of Forestry and Fire Protection) with the Sims Rainmaker collapsible helibucket (referred to as the CDF Bell S205 with 300-gallon Sims collapsible helibucket) is one of a family of helicopters designed for fire suppression with a helibucket. The CDF Bell S205 is qualified as a Type 2 helicopter.

The helibucket (figure 1) is constructed of hard-sided fiberglass with two telescoping sections. The sections are extended during operation and retracted during storage. The bottom of the tank is flat and round. The tank has two semi-circular doors. The doors are hinged along the straight side of the semicircle and open inward when a telescoping cylinder is activated. The helibucket is evacuated by activating an electric hydraulic system using 28 volts dc aircraft power. The system opens both doors, providing one flow rate. The helibucket is 59 inches wide and 36½ inches high. The door opening is 40 inches wide.

The Missoula Technology and Development Center tested the CDF Bell S205 with 300-gallon Sims collapsible helibucket with a series of drops over an array of plastic bowls much like Cool Whip containers. The quantity of material in each bowl was measured, and the data were used to determine the drop pattern.

The drops in these tests were made with the helibucket's maximum volume of 300 gallons. Tests included airspeeds from 18 to 85 knots (21 to 98 miles per hour) and drop heights from 29 to 68 feet from the bottom of the tank to the ground. The drops were made with two different materials: water and foam.

Flow rate, drop height, and airspeed all affect the drop pattern. Because this type of helicopter is normally used over a narrow range of heights and speeds and because this system produces a single flow rate, information about an average drop is presented.

Figure 1—A static test of the 300-gallon Sims collapsible helibucket.

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Figures 2, 3, 4, and 5 show the effect of increasing airspeed from 21 to 80 knots (24 to 92 miles per hour) with drop heights ranging from 33 to 54 feet while using water.

The proper amount of fire-retarding materials to be applied (expressed as coverage levels in gallons per 100 square feet) differs depending on the fuel model. Table 1 shows the coverage needed for specific fuel models using both the National Fire Danger Rating System (NFDRS) and Fire Behavior Fuel Model descriptions.

The results of drop tests allow managers to estimate the length of line a specific airtanker produces at various coverage levels. Table 2 or figure 6 can be used to determine the

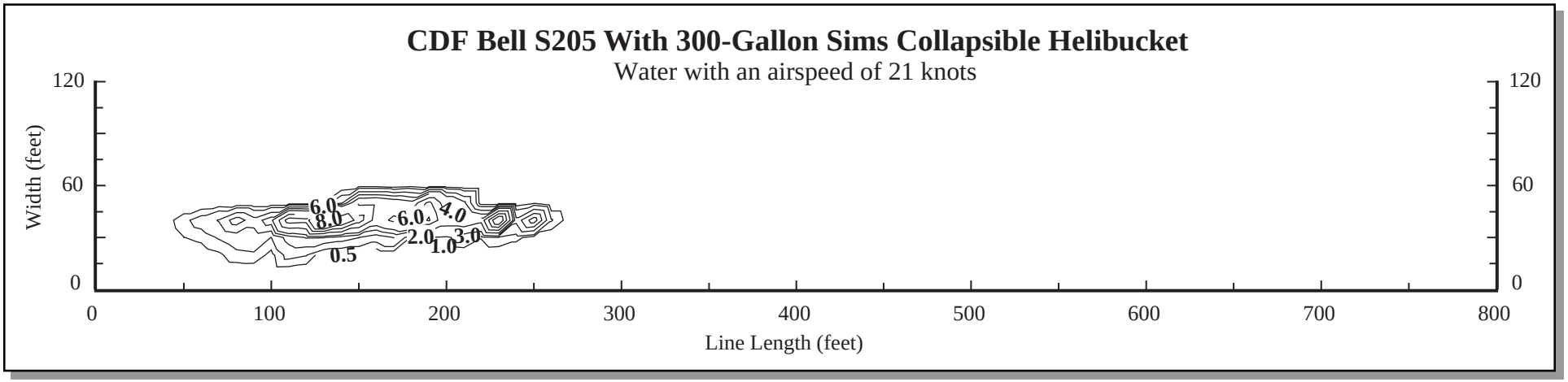

Figure 2—Drop pattern characteristics for the CDF Bell S205 with 300-gallon Sims collapsible helibucket using water at an airspeed of 21 knots (24 miles per hour) and a drop height of 33 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

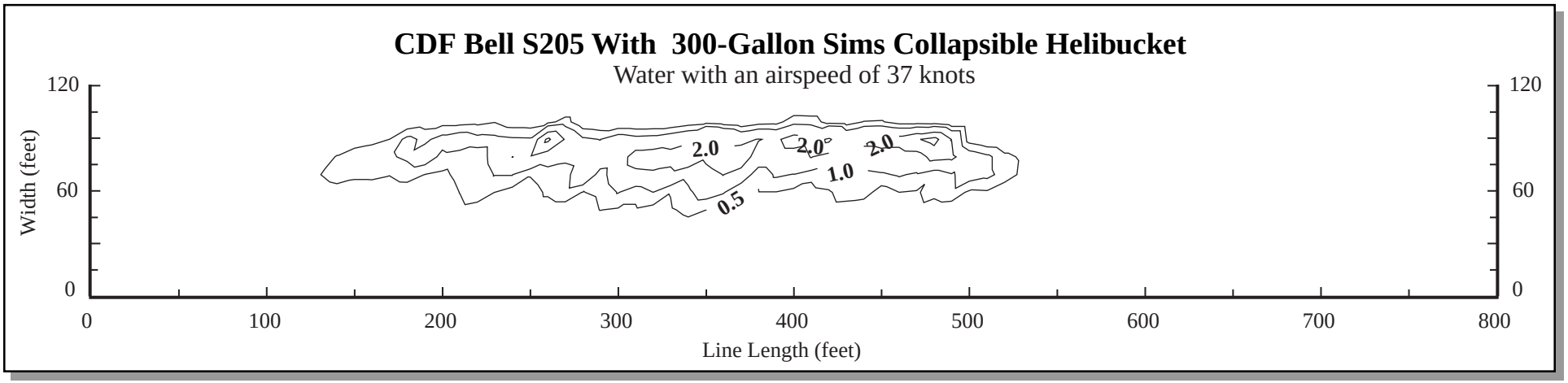

Figure 3—Drop pattern characteristics for the CDF Bell S205 with 300-gallon Sims collapsible helibucket using water at an airspeed of 37 knots (43 miles per hour) and a drop height of 53 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

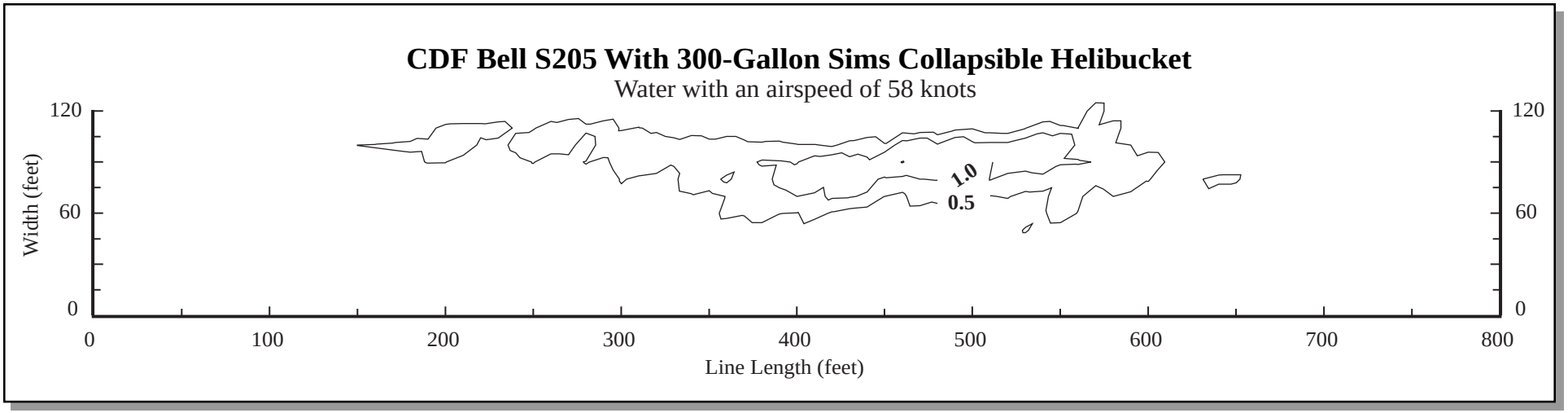

Figure 4—Drop pattern characteristics for the CDF Bell S205 with 300-gallon Sims collapsible helibucket using water at an airspeed of 58 knots (67 miles per hour) and a drop height of 54 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

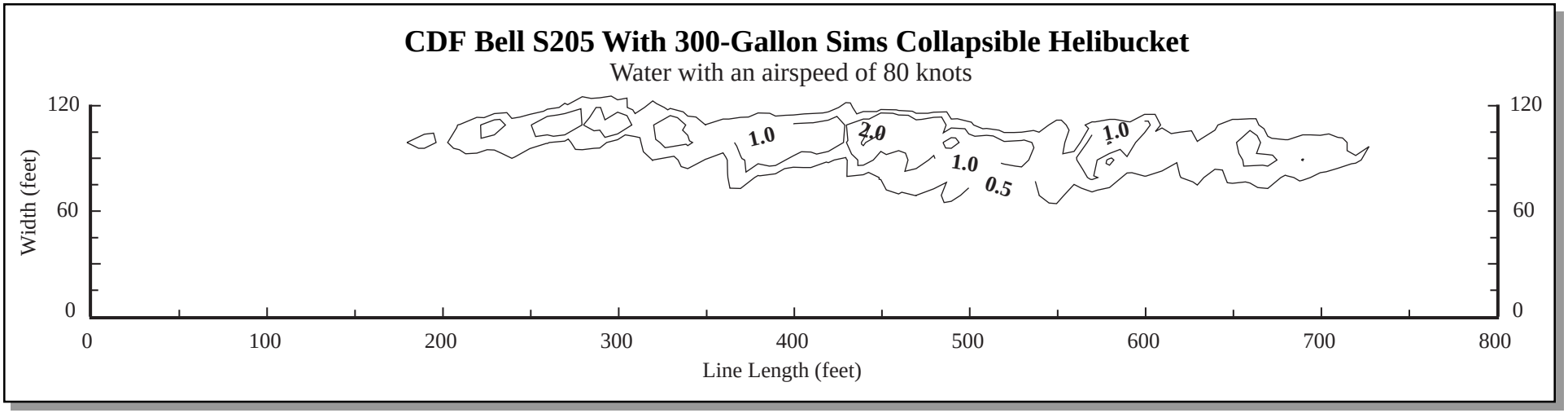

Figure 5—Drop pattern characteristics for the CDF Bell S205 with 300-gallon Sims collapsible helibucket using water at an airspeed of 80 knots (92 miles per hour) and a drop height of 38 feet. The contour lines are at coverage levels of 0.5, 1, 2, 3, 4, 6, 8, and 10 gallons per 100 square feet.

Table 1—The retardant coverage needed for specific fuel types.

Fuel Model		Coverage Level (gal/100 ft²)	Description
National Fire Danger Rating System (NFDRS)	Fire Behavior		
A, L, S	1	1	Annual and perennial western grasses, tundra
C	2		Conifer with grass
H, R	8	2	Shortneedle closed conifer; summer hardwood
E, P, U	9		Longneedle conifer; fall hardwood
T	2		Sagebrush with grass
N	3		Sawgrass
F	5	3	Intermediate brush (green)
K	11		Light slash
G	10	4	Shortneedle conifer (heavy dead litter)
O	4		Southern rough
F, Q	6	6	Intermediate brush (cured), Alaska black spruce
B, O	4		California mixed chaparral, high pocosin
J	12	Greater than 6	Medium slash
I	13		Heavy slash

airspeed of a water drop required to obtain maximum line length at each coverage level. Table 3 or figure 7 can be used to determine the airspeed of a foam drop required to obtain maximum line length at each coverage level.

The line length graphs predict line length (in feet) as a function of airspeed (in knots). The tables are constructed by selecting the drop producing the longest line (on the ground) at each coverage level. Either the graphs or the tables may be used

Table 2—Water tests producing the longest line at various coverage levels.

Coverage Level (gal/100 ft²)	Line Length (feet)	Airspeed (knots)
0.5	536	80
1	336	68
2	268	38
3	165	40
4	142	19
6	101	18
8	70	18
10	34	18

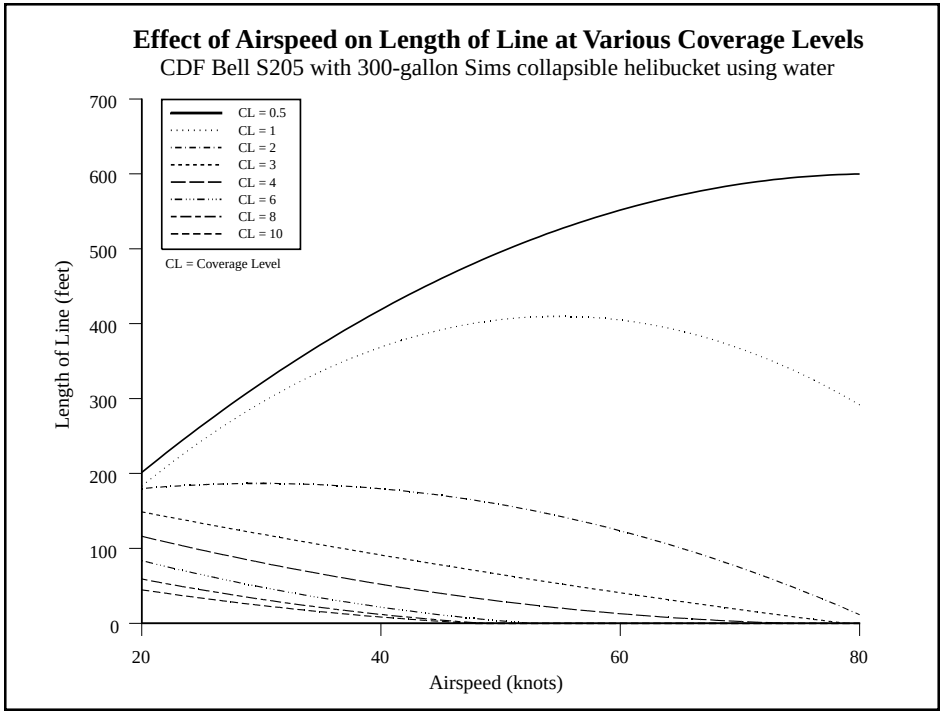

Figure 6—Use this graph to estimate the airspeed needed to provide the longest line of water at various coverage levels.

Table 3—Foam tests producing the longest line at various coverage levels.

Coverage Level (gal/100 ft²)	Line Length (feet)	Airspeed (knots)
0.5	645	80
1	483	37
2	241	39
3	142	21
4	124	21
6	95	21
8	81	21
10	67	21

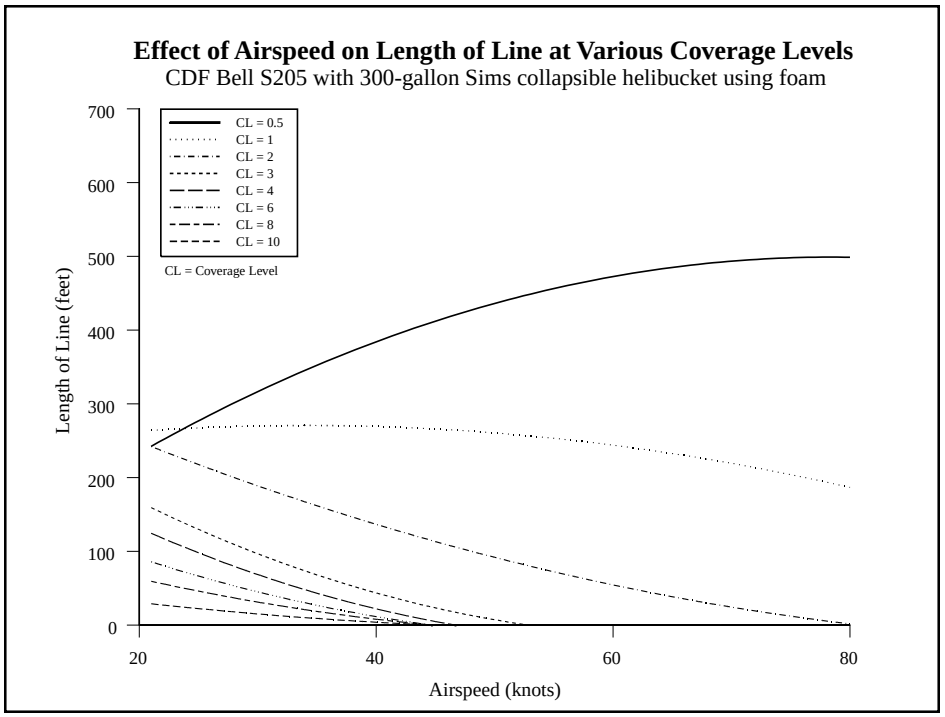

Figure 7—Use this graph to estimate the airspeed needed to provide the longest line of foam at various coverage levels.

to estimate the airspeed required to produce the longest line for a given coverage level. The tables show an ideal case, while the graphs represent an average.

To select the proper airspeed, first use table 1 to determine the coverage level required by the NFDRS or Fire Behavior Fuel Model. The coverage levels in table 1 represent the coverage level required for average fire intensity for each fuel model. The required coverage level can be adjusted up or down depending on the actual fire intensity. Once the required coverage level is determined, the airspeed can be found. Use the table for the material dropped (water or foam) to find the airspeed that produces the longest line for the desired coverage level. The same information can be found in the appropriate drop table.

For example, if a fire is burning in NFDRS Fuel Model B, O (Fire Behavior Model 4), represented by California mixed chaparral or high pocosin, table 1 shows that a coverage level greater than 6 is required. The table for water shows that for coverage level 6, an airspeed of about 18 knots produces the longest line (101 feet).

The ground drop characteristics for the CDF Bell S205 with 300-gallon Sims collapsible helibucket were derived through controlled test drop procedures on flat ground (figure 8). This information is to serve only as a guide in assisting field personnel to determine the proper drop height and airspeed for delivering water or foam. Actual coverage may vary depending on terrain, wind, weather, and pilot proficiency.

Figure 8–Drop test of the CDF Bell S205 with 300-gallon Sims collapsible helibucket using water.

About the Authors...

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