Level of Service Freeway Definitions

TABLE A-1
Level of service criteria for basic freeway segment

Level of Service	Density (passenger car/mi/ln)	Traffic Flow Characteristics
A	≤ 11	Free flows operation, vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.
B	> 11 - ≤ 18	Reasonably free flow, vehicles maneuver within the traffic stream is only slightly restricted.
C	> 18 - ≤ 26	Freedom to maneuver within the traffic stream is noticeably restricted.
D	> 26 - ≤ 35	Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort level.
E	> 35 - ≤ 45	Vehicles are closely spaced, leaving little room to maneuver within the traffic stream at speed that still exceed 49 mph.
F	> 45	Breakdowns in vehicular flow.

Source: Highway Capacity Manual (HCM), 2000

Level of Service A describes primarily free-flow operations. Average travel speeds near 60 mph generally prevail on 70-mph freeway elements. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The average spacing between vehicles is about 440 feet, or 22 car lengths, with a maximum density of 12 pc/mi/ln. This affords the motorist a high level of physical and psychological comfort. The effects of minor incidents or breakdowns are easily absorbed at LOS A. Although they might cause a deterioration in LOS in the vicinity of the incident, standing queues would not form and traffic would quickly return to LOS A after passing the disruption.

Level of Service B also represents reasonably free-flow conditions, and speeds of over 57 mph are maintained on 70-mph freeway elements. The average spacing between vehicles is about 260 feet, or 13 car lengths, with a maximum density of 20/pc/mi/ln. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is high. The effects of minor incidents and breakdowns are still easily absorbed, although local deterioration in service would be more severe than for LOS A.

Level of Service C describes stable operations, but flows approach the range in which small increases in flow will cause substantial deterioration in service. Average travel speeds are still over 54 mph. Freedom to maneuver within the traffic stream is noticeably restricted at LOS C, and lane changes require additional care and vigilance by the driver. Average spacing is in the range of 175 feet, or nine car lengths, with a maximum density of 30/pc/mi/ln. Minor incidents can still be absorbed, but the local deterioration in service will be substantial. Queues could be expected to form behind any significant blockage. The

driver experiences a noticeable increase in tension because of the additional vigilance required for safe operation.

Level of Service D borders on unstable flow. In this range, small increases in flow cause substantial deterioration in service. Average travel speeds of 46 mph or more can still be maintained on 70-mph freeway elements. Freedom to maneuver within the traffic stream is severely limited, and the driver experiences drastically reduced physical and psychological comfort levels. Even minor incidents can be expected to create substantial queuing because the traffic stream has little space to absorb disruptions. Average spacing is about 125 feet, or six car lengths, with a maximum density of 42/pc/mi/ln.

Level of Service E describes operation at capacity. Operations at LOS E are extremely unstable because there are virtually no usable gaps in the traffic stream. Vehicles are spaced at approximately 80 feet, or four car lengths, at relatively uniform headways. This, however, represents the minimum spacing at which stable flow can be accommodated. Any disruption to the traffic stream, such as a vehicle entering from a ramp or a vehicle changing lanes, causes following vehicles to give way to admit the vehicle. This condition establishes a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruptions. Any incident can be expected to produce a serious breakdown with extensive queuing. The range of flows encompassed by LOS E is relatively small compared to other levels, but reflects a substantial deterioration in service. Maneuverability within the traffic stream is extremely limited, and the level of physical and psychological comfort afforded to the driver is extremely poor. Average travel speeds are approximately 30 mph.

Level of Service F describes forces or breakdown flow. Such conditions generally exist within queues forming behind breakdown points. Such breakdowns occur for a number of reasons:

- Traffic incidents cause a temporary reduction in the capacity of a short segments, so that the number of vehicles arriving at the point is greater than the number of vehicles that can traverse it.
- Recurring points of congestion exist, such as merge or weaving areas and lane drops, where the number of vehicles arriving is greater than the number of vehicles traversing the point.
- In forecasting situations, any location presents a problem when the projected peak-hour (or other) flow rate exceeds the estimated capacity of the location.

In all cases, breakdown occurs when the ratio of actual arrival flow rate to actual capacity or the forecast flow rate to estimated capacity exceeds 1.00. Operations at such a point will generally be at or near capacity, and downstream operations may be better as vehicles pass the bottleneck (assuming that there are no additional downstream problems). The LOS F operations observed within a queue are the result of a breakdown or bottleneck at a downstream point. The designation LOS F is used, therefore, to identify the point of the breakdown or bottleneck as well as the operations within the queue that forms behind it.

Level of Service Urban Street Definitions

TABLE
HCM Urban Street LOS Classification

Level of Service	Description
A	The roadway primarily operates at free-flow operations at an average travel speeds, usually about 90 percent of the free-flow speed for the given street class. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Control delay at signalized intersections is minimal.
B	The roadway reasonably operates at unimpeded operations at an average travel speeds, usually about 70 percent of the free-flow speed for the given street class. The ability to maneuver within the traffic stream is only slightly restricted and control delay at signalized intersections are not significant.
C	The roadway operates at stable operations, however, the ability to maneuver and change lanes in midblock locations may be more restricted than at LOS B, and longer queues, adverse signal coordination, or both may contribute to lower average travel speeds of about 50 percent of the free-flow speed for the given street class.
D	The roadway boards on a range in which small increases in flow may cause substantial increases in delay and decreases in travel speeds. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or a combination of these factors. Average travel speeds are about 40 percent of roadways free-flow speed.
E	The roadway is characterized by significant delays and average travel speeds of 33 percent or less of the roadways free-flow speed. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.
F	The roadway is characterized by urban street flow at extremely low speeds, typically one-third to one-fourth of the roadways free-flow speed. Intersection congestion is likely at critical signalized locations, with high delays, high volumes, and extensive queuing.

Source: 2000 Highway Capacity Manual

Level of Service Two-Lane Rural Highway Definitions

Two-Lane Rural Highway LOS

Primary measures for service quality for Class 1 facilities are percent time-spent-following and average travel speed. For Class 2 facilities the measure for service quality is based on percent time-spent-following.

TABLE
HCM 2-Lane Highway LOS Classification

Level of Service	Description
A	Motorists are able to travel at their desired speed. Without strict enforcement, this highest quality would result in average speeds of 55 mph or more on two-lane highways in Class 1. The passing frequency required to maintain these speeds has not reached a demanding level, so that passing demand is well below passing capacity, and platoons of three or more vehicles are rare. Drivers are delayed no more than 35 percent of their travel time by slower-moving vehicles. A maximum flow rate of 490 pc/h total in both directions may be achieved with base conditions. On Class II highways, speeds may fall below 55 mph, but motorists will not be delayed in platoons for more than 40 percent of their travel time.
B	Traffic flow is speeds of 50 mph or slightly higher on level terrain Class 1 highways. The demand for passing to maintain desired speeds becomes significant and approximates the passing capacity at the lower boundary of LOS B. Drivers are delayed in platoons for up to 50 percent of the time. Service flow rates of 780 pc/h total in both directions may be achieved with base conditions. On Class II highways, speeds may fall below 50 mph, but motorists will not be delayed in platoons for more than 55 percent of their travel time.
C	Flow increases, resulting in noticeable increases in platoon formation, platoon size and frequency of passing impediments. The average speed still exceeds 45 mph on level terrain Class 1 highways, even though unrestricted passing demand exceeds passing capacity. At higher volumes the chaining of platoons and significant reductions in passing capacity occur. Although traffic flow is stable, it is susceptible to congestion due to turning traffic and slow-moving vehicles. Percent time-spent-following may reach 65 percent of the time. Service flow rates of 1,190 pc/h total in both directions may be achieved with base conditions. On Class II highways, speeds may fall below 45 mph, but motorists will not be delayed in platoons for more than 70 percent of their travel time.
D	LOS D represents unstable flow. The two opposing traffic streams begin to operate separately at higher volume levels, as passing becomes extremely difficult. Passing demand is high, but passing capacity approaches zero. Mean platoon sizes of 5 to 10 vehicles are common, although speeds of 40 mph still can be maintained under base conditions on Class 1 highways. The proportions of no-passing zones along the roadway section usually has little influence on passing. Turning vehicles and roadside distractions cause major shock waves in the traffic stream. Motorists are delayed in platoons for nearly 80 percent of their travel time. Maximum service flow rates of 1,830 pc/h total in both directions may be achieved with base conditions. On Class II highways, speeds may fall below 40 mph, but in no cases will motorists be delayed in platoons for more than 85 percent of their travel time.
E	Traffic flow conditions have a percent time-spent-following greater than 80 percent on Class 1 highways and greater than 85 percent on Class II. Even under base conditions, speeds may drop below 40 mph. Average travel speeds on highways with less than base conditions will be slower, even down to 25 mph on sustained upgrades. Passing is virtually

TABLE
HCM 2-Lane Highway LOS Classification

Level of Service	Description
	impossible and platooning becomes intense as slower vehicles or other interruptions are encountered. The highest volume attainable under LOS E defines the capacity of the highway, generally 3,200 pc/h in both directions. Operating conditions at capacity are unstable and difficult to predict. Traffic operations seldom reach near capacity on rural highways, primarily because lack of demand.
F	Represents heavily congested flow with traffic demand exceeding capacity. Volumes are lower than capacity and speeds are highly variable.

Source: 2000 Highway Capacity Manual

Federal Aviation Administration
Northwest Mountain Regional Office
1601 Lind Avenue SW-ANM-520
Renton, WA 98055-4056

AERONAUTICAL STUDY NO.
2002-ANM-1053-OE
PRIOR STUDY NO.

Issued Date: 10/28/2002

ANDREW YOUNG
ZILKHA RENEWABLE ENERGY
210 S.W. MORRISON STREET
PORTLAND, OR 97204

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has completed an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure Type:	Wind Turbine G-02
Location:	CLE ELUM, WA
Latitude:	47-7-19.37 NAD83
Longitude:	120-42-33.28
Heights:	350 feet above ground level (AGL) 2730 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking and/or lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA advisory Circular 70/7460-1 AC70/7460-1K.

This determination expires on 4/28/2004 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed , as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

A copy of this determination will be forwarded to the Federal Communications Commission if the structure is subject to their licensing authority.

If we can be of further assistance, please contact our office at (425)227-1283. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2002-ANM-1053-OE.

(DNE)

Duane Van Hoosen
Specialist

Federal Aviation Administration
Northwest Mountain Regional Office
1601 Lind Avenue SW-ANM-520
Renton, WA 98055-4056

AERONAUTICAL STUDY NO.
2002-ANM-1052-OE
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Issued Date: 10/28/2002

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**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has completed an aeronautical study under the provisions of 49 U.S.C., Section 44718 and, if applicable, Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure Type:	Wind Turbine G-01
Location:	CLE ELUM, WA
Latitude:	47-7-26.68 NAD83
Longitude:	120-42-37.97
Heights:	350 feet above ground level (AGL) 2730 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

As a condition to this Determination, the structure should be marked and/or lighted in accordance with FAA Advisory Circular 70/7460-1 AC70/7460-1K, Obstruction Marking and Lighting, a med-dual system - Chapters 4,8(M-Dual),&12.

This determination expires on 4/28/2004 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed , as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.