SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

LONG TERM STABLE SLOPE LINE: consists of the **Stability Component** and the **Erosion Component**

STABILITY COMPONENT

Definition: The setback gradient line measured from the toe of the slope, or channel assuming the location of the toe remains fixed with time. (See Figures 1, 3 and 4b and 4c).

Factors for Consideration:

- soil strength
- groundwater conditions
- slope geometry
- condition of vegetation
- changing load conditions
- weathering of slope face
- increases in surface runoff over slope

Method of Calculation:

- There are three methods of establishing this component. Each method is progressively more involved as indicated in Figure 2.

Factor of Safety:

- Minimum Factor of safety of 1.5 is required.

EROSION COMPONENT

Definition: The regression of the slope toe/channel bank due to erosion over the design life of the structure at the crest of the slope and is measured as a horizontal distance. (See Figures 1, 4b, and 4c).

Factors for Consideration:

- proximity of the slope toe to the watercourse
- average and peak flow rates and velocities of the watercourse
- susceptibility of the soils to erosion
- type and extent of vegetation
- sediment load carried by the watercourse
- fluvial geomorphological processes affecting the reach within which the site is located.
- increases in surface runoff over slope
- weathering of slope face

Method of Calculation:

- As outlined in Figure 4a, the distance from the toe of the valley wall to the watercourse channel bank as well as the design erosion allowance must be determined. The erosion is measured horizontally from the top of the channel bank or the location of the bankfull flow, whichever is lower in elevation (Figure 4c).

DEVELOPMENT SETBACK COMPONENT

Definition: A minimum allowance from the identified slope hazard area to take into account external conditions which could have an adverse effect on the existing natural conditions of the slope. This setback distance maybe superseded by more stringent municipal or provincial requirements. For minimum allowance refer to CVC's Watershed Planning and Regulation Policies (2010).

Factors for Consideration:

- provide an access point along the crest of the slope
- keep heavy equipment away from the slope
- allow for the redirection of surface flows away form the slope hazard area
- allow for the placement of sediment control measures and limit of working easement if necessary.
- provide tableland area for potential future revegetation and/or reforestation (e.g. Credit Valley Conservation Authority planting programme)

Method of Calculation:

- Measured as the horizontal distance from the approved top of bank or from the combined distance derived from the Stability and Erosion Components whichever is the greater. (see Figure 1).

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Figure 1. Typical Valley Wall Slopes

FIGURE 1a: STABLE WELL VEGETATED VALLEY WALL SLOPE WITH WIDE FLOODPLAIN OR EROSION PROTECTION

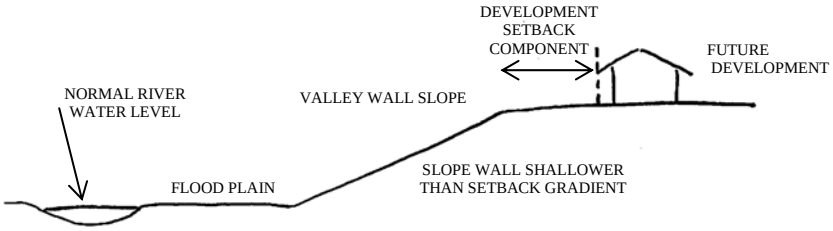

FIGURE 1b: OVERSTEEPENED VALLEY WALL SLOPE WITH WIDE FLOOD PLAIN OR EROSION PROTECTION

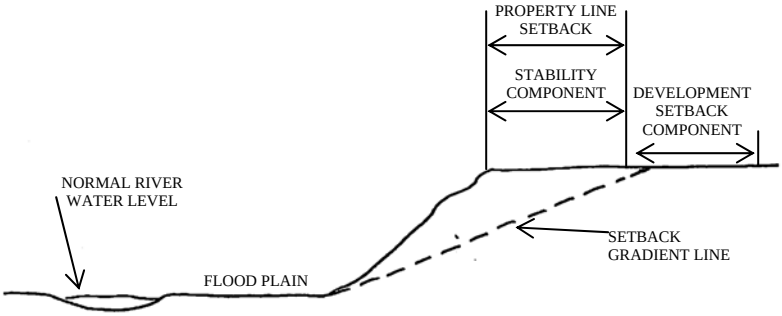

FIGURE 1c: OVERSTEEPENED VALLEY WALL SLOPE SUBJECT TO TOE EROSION

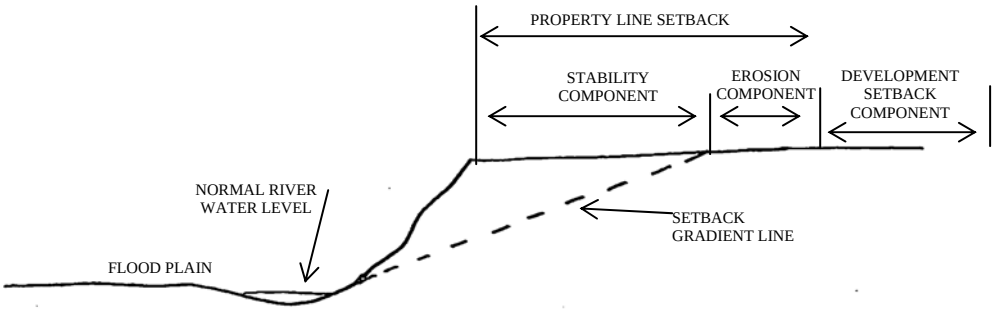

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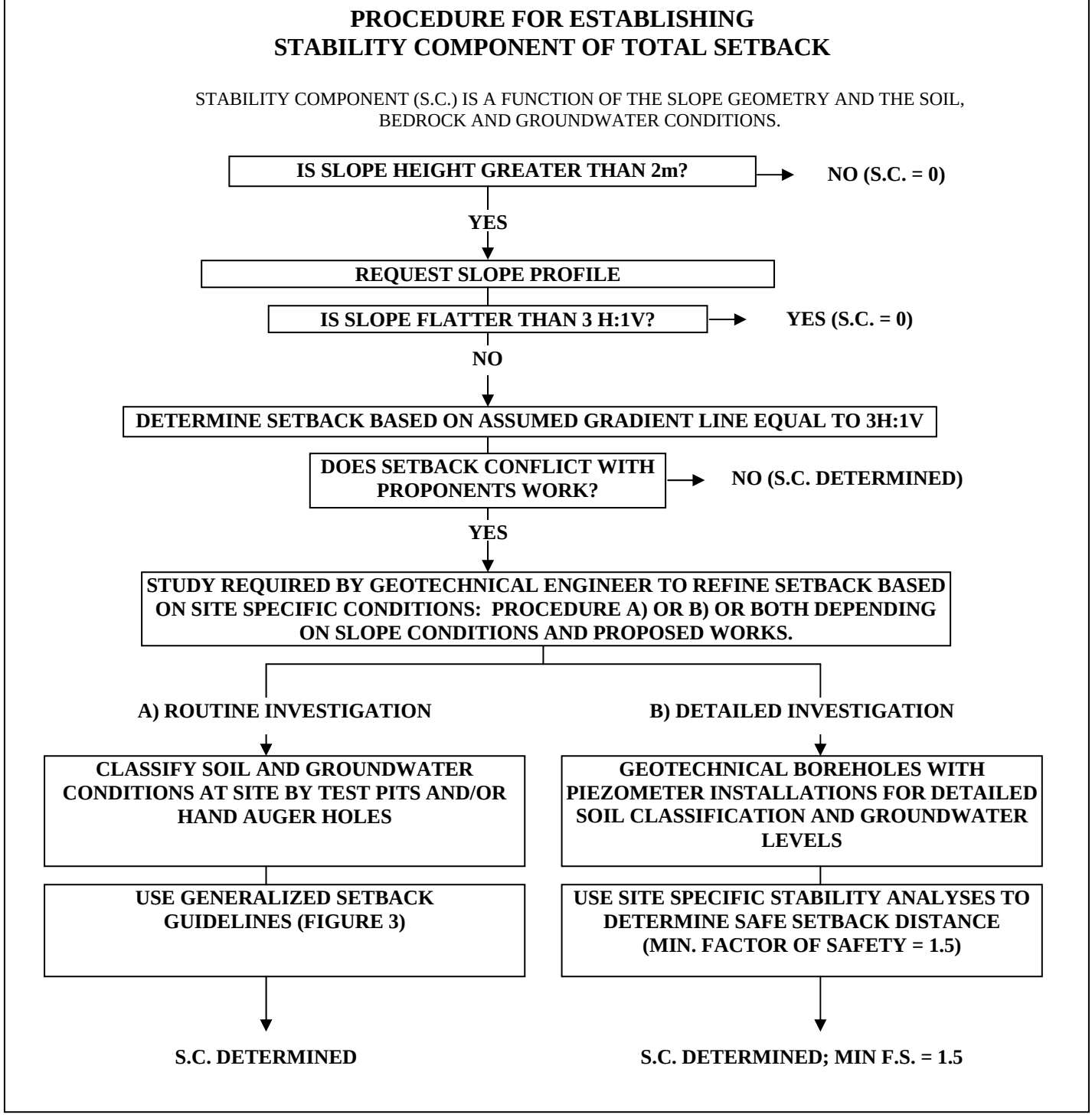
Figure 2. Stability Component Determination

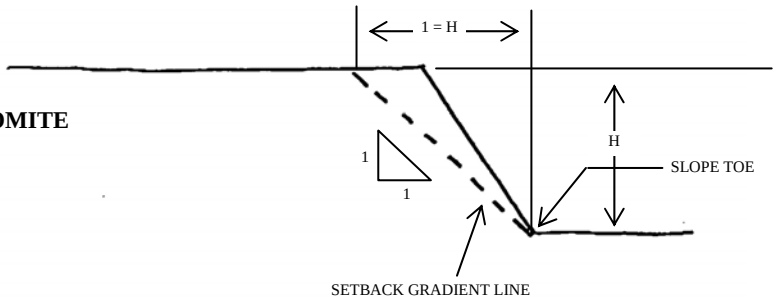


SLOPE STABILITY DEFINITION & DETERMINATION GUIDELINE

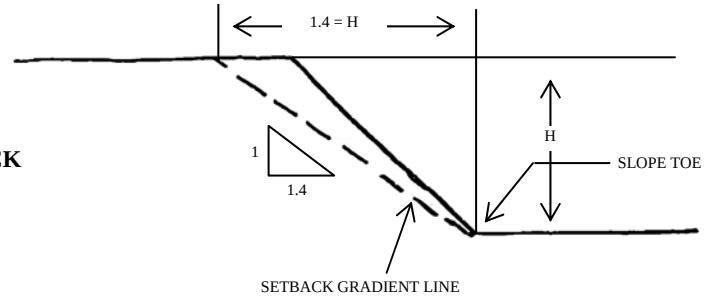
Figure 3. Generalized Stability Setback Guidelines

GUIDELINES FOR ESTABLISHING STABILITY COMPONENT OF TOTAL SETBACK FOR TYPICAL BEDROCK / SOIL CLASSIFICATIONS WITHIN THE CREDIT RIVER WATERSHED

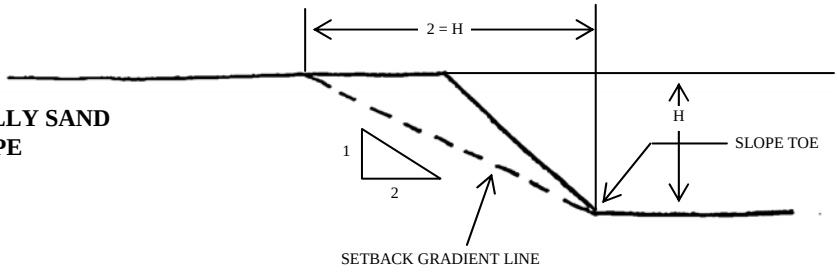
LIMESTONE / DOLOMITE BEDROCK



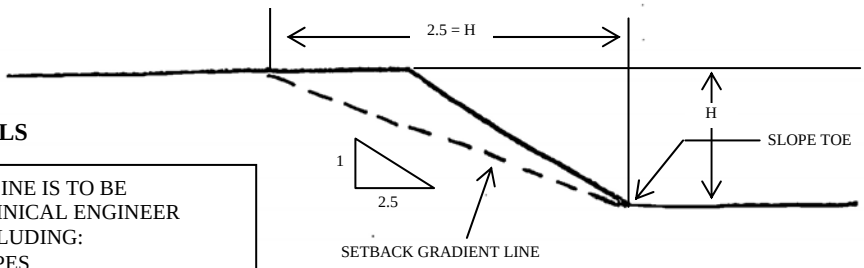
SHALE BEDROCK



SAND AND GRAVELLY SAND "DRY" SLOPE



CLAY TILLS



THE SETBACK GRADIENT LINE IS TO BE DETERMINED BY GEOTECHNICAL ENGINEER FOR ALL OTHER SOILS INCLUDING:

- CLAY (NON TILL) SLOPES
- SAND SLOPES WITH WATER SEEPAGE
- FILL SLOPES

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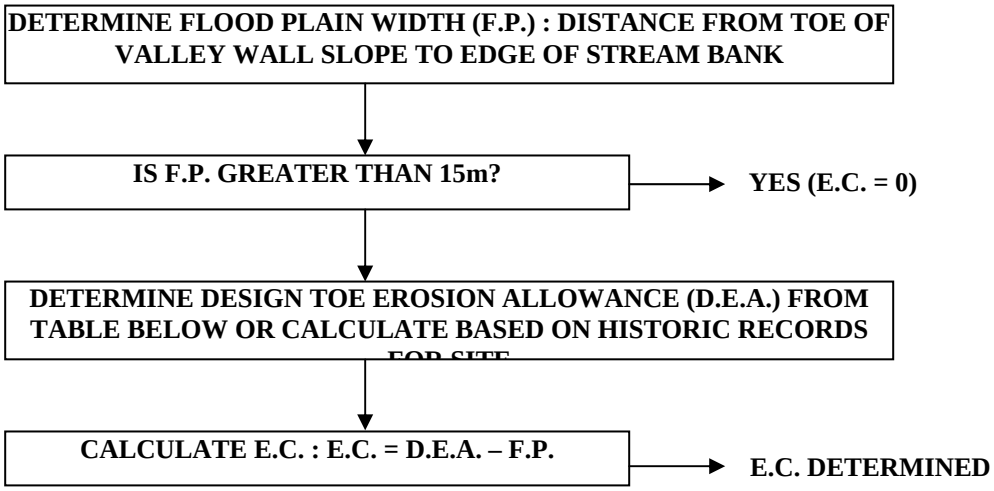
Figure 4a. Erosion Component Determination

PROCEDURE FOR ESTABLISHING EROSION COMPONENT OF TOTAL SETBACK

EROSION COMPONENT (E.C.) IS A FUNCTION OF THE RATE OF EROSION OF THE STREAM BANK OR VALLEY WALL SLOPE.



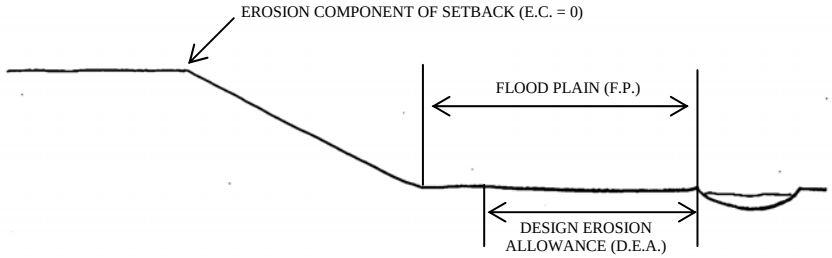
Notes: - E.C. cannot be less than zero
- if F.P. is greater than D.E.A. then E.C. = 0

SUGGESTED DESIGN TOE EROSION ALLOWANCE

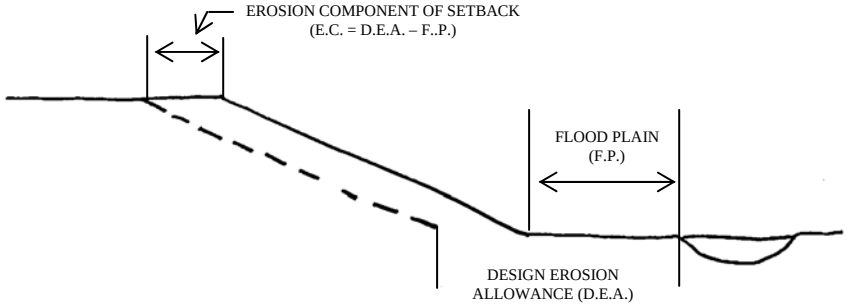
MATERIAL AT CHANNEL BANK OR BANK FULL / BANK CONDITION	ACTIVE EROSION OF BANK	EROSION CURRENTLY NOT EVIDENT	EXISTING EROSION PROTECTION IN PLACE AND MAINTAINED ALONG BANK
LIMESTONE DOLOSTONE	2m	1m	0
SHALE	5m	2m	0
COHESIVE SOILS; SILTY CLAYS, CLAYEY SILTS	8m	4m	0
COHESIONLESS SOILS; SILTS, SANDS	15m	7m	0

Figure 4b. Calculation of Erosion Component of Total Setback with Defined Valley Slope

(A) FLOOD PLAIN WIDTH GREATER THAN DESIGN EROSION ALLOWANCE



(B) FLOOD PLAIN WIDTH LESS THAN DESIGN EROSION ALLOWANCE



(C) NO FLOOD PLAIN AT THE TOE OF SLOPE

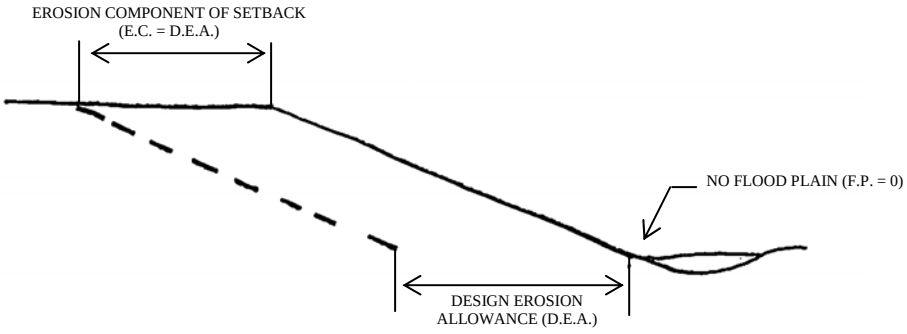


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Figure 5. Example of Stability, Erosion and Development Setback Components

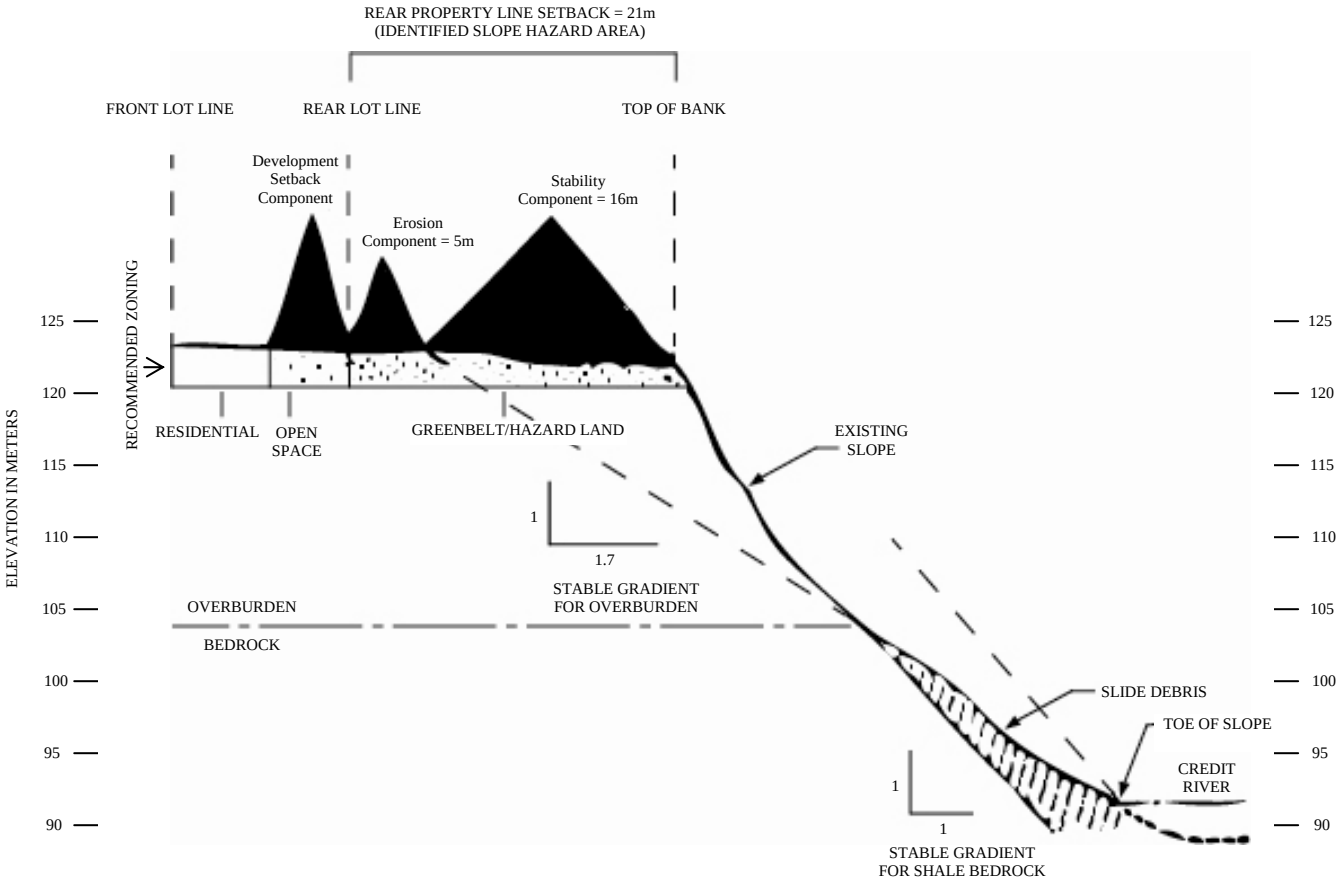

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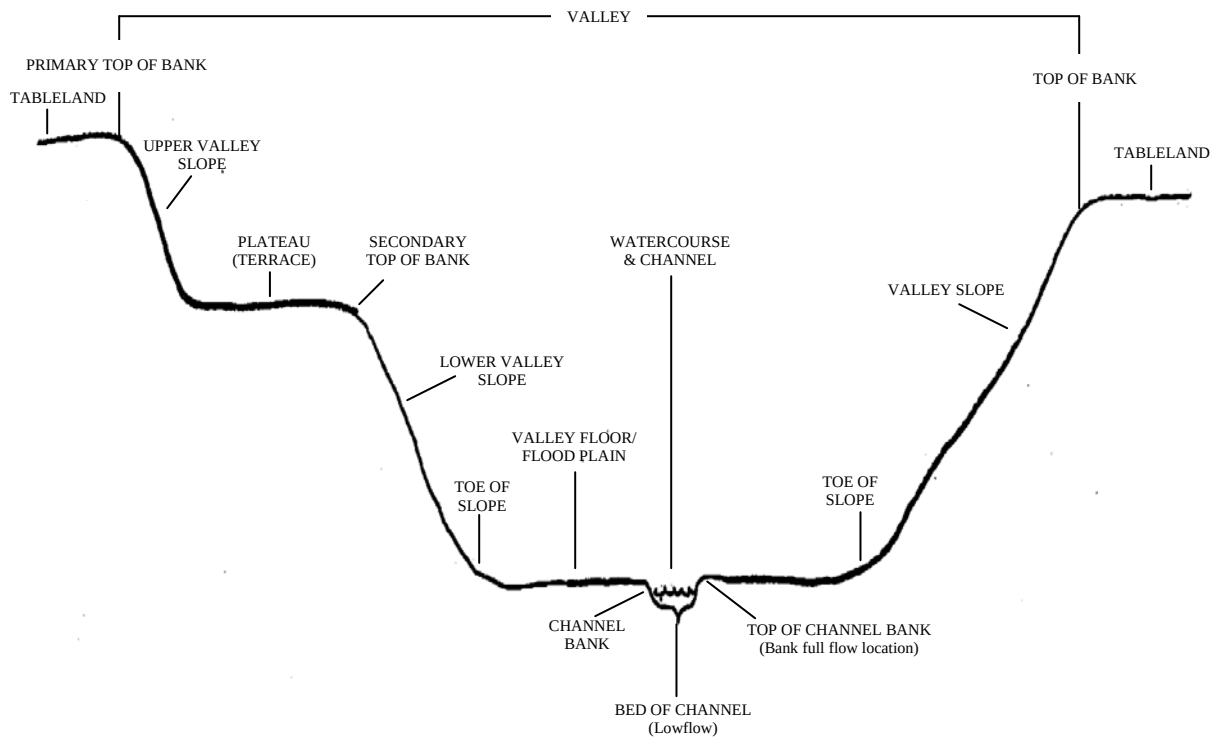
Figure 6. The Physical Features of a Typical Valley



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