9. ATTACHMENTS

ATTACHMENT I

Mathematical formulation

The objective functions and endogenous restrictions have the following expressions:

$$\max Z = \sum_{i=1}^{I} \sum_{p=1}^{P} v_{ip}.x_{ip}$$

Subject to:

$$\sum_{p=1}^{P} x_{ip} \leq 1 \quad \forall i = 1,2,...,n$$

Where

I = Number of harvest units

i = Harvest unit identifier

P = Planning horizon

p = The period

x_{ip} is a binary variable so that:

$$x_{ip} = \begin{cases} 1 \text{ if the unit } i \text{ will be harvest in period } p \\ 0 \text{ in other cases} \end{cases}$$

v_{ip} is the coefficient of the objective function, such as HF or NPV

The exogenous constraints have the following expressions:

- Flow constraints:

$$(1 + \alpha) \sum_{i=1}^{I} v_{ip}\, x_{ip} \leq \sum_{i=1}^{I} v_{i(p+1)} x_{i(p+1)}\,, \forall p = 1, ..., P$$

$$(1 - \alpha) \sum_{i=1}^{I} v_{i(p-1)} x_{i(p-1)} \geq \sum_{i=1}^{I} v_{ip}\, x_{ip}, \forall p = 1, ..., P$$

Where:

α is the fractional difference permitted in the flow level between two consequential period

- Adjacency constrains:

$$M \cdot x \leq A$$

$$M = A + B$$

Where:

A = Adjacency matrix

M = Modified adjacency matrix

x = Control vector

1 is an $(n \times 1)$ unit vector

ATTACHMENT II

Cuts scheduling
Alternative I
5%HF

Not harvested
1st period
2nd period
3rd period

0   0,2 0,4   0,8 Kilometers

Cuts scheduling

Alternative I

10% HF

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 2 4 8 Kilometers

Cuts scheduling

Alternative I

15% HF

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative II

5% HF

- Not harvesting
- 1st period
- 2nd period
- 3rd period

0 0,2 0,4   0,8 Kilometers

Cuts scheduling

Alternative II

10% HF

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 2 4 8 Kilometers

Cuts scheduling

Alternative II

15% HF

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative III

5% HF

- Not harvested
- 1st period
- 2nd period
- 3rd period

0   0,2 0,4   0,8 Kilometers

Cuts scheduling

Alternative III

10% HF

Not harvested
1st period
2nd period
3rd period

0   2   4   8 Kilometers

Cuts scheduling

Alternative III

15% HF

- Not havested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers

Cuts sheduling

Alternative I

5% NPV

	Not harvested
	1st period
	2nd period
	3rd period

0   0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative I

10% NPV

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative I

15% NPV

Not harvested
1st period
2nd period
3rd period

Cuts sheduling

Alternative II

5 % NPV

Not harvested
1st period
2nd period
3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative II

10% NPV

Not harvested
1st period
2nd period
3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative II

15% NPV

Not harvested
1st period
2nd period
3rd period

0   0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative III

5% NPV

Not harvested
1st period
2nd period
3rd period

Cuts scheduling

Alternative III

10% NPV

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers

Cuts scheduling

Alternative III

15% NPV

- Not harvested
- 1st period
- 2nd period
- 3rd period

0 0,15 0,3   0,6 Kilometers