PAMF Cost Estimation Details
Understanding PAMF Treatment Cost Calculations

This information is provided to help you understand the cost estimates provided in the Web Hub Reports. Each equation shown here is a calculation of the cost of treatment for a particular management unit (MU). Equations include the information gathered from the land manager and the constants which are calculated, for simplicity’s sake, using market values, and other land manager’s experiences.

Assumptions

Several assumptions are included in the calculations, as follows:

- Every MU will have the same amount of Phragmites per acre.
- Each m² of a MU is filled with Phragmites.
- Maintenance costs for machinery and equipment, and wear and tear costs, are not included.
- The cost of small supplies: e.g. trimmers, rakes, replacements, etc., are not included.
- Travel costs to the MU are not included.
- All machines (except for pumps) need a human to be run and the human hours equal the time of machine operation. ¹
- In the case of herbicide treatment, the cost of surfactant is not included.

¹ Average labor rates will be developed for each worker category.
1. Herbicides

There are three different situations for herbicides applied to a PAMF management unit (MU):

1. The participant hired a contractor. See Equation 1.1
2. The participant applied herbicide with their own equipment. See Equation 1.2
3. The participant applied herbicide with rented equipment. See Equation 1.3

Equation 1.1:
\[ \text{Cost (USD)} = \left( \text{Cost}_\text{service (USD)} \times \text{A}_{\text{proportion}} \right) \]

**Land manager fills out:**

\[ \text{Cost}_\text{service (USD)} \]  How much did the service cost?

**Known values or constants:**

Ex: MU area accounts for what proportion of total area treated?

\[ \text{A}_{\text{proportion}} = \frac{\text{A}_{\text{MU}} \text{ (acres)}}{\text{A}_{\text{land treated}} \text{ (acres)}} \]

Equation 1.2:
\[ \text{Cost (USD)} = \left( \text{Cost}_\text{product} \frac{\text{USD}}{\text{gal}_{\text{product}}} \times \text{C}_{\text{product}} \frac{\text{gal}_{\text{product}}}{\text{gal}_{\text{mix}}} \times V_{\text{mix}}(\text{gal}_{\text{mix}}) + \left( \text{Cost}_\text{fuel} \frac{\text{USD}}{\text{gal}} \times V_{\text{fuel}}(\text{gal}) \right) \right) \]
\[ + \left( \text{Cost}_\text{operating equipment} \frac{\text{USD}}{\text{h}} \times \text{Human hours (h)} \right) \]
\[ + \left( \text{Cost}_\text{labor} \frac{\text{USD}}{\text{h}} \times \text{Human hours x(h)} \right) \right) \times \text{A}_{\text{proportion}} \]

**Land manager fills out:**

\[ \text{C}_{\text{product}} \frac{\text{gal}_{\text{product}}}{\text{gal}_{\text{mix}}} \]  % Concentration of the product (by volume)

\[ V_{\text{mix}}(\text{gal}_{\text{mix}}) \]  How much of the mix was applied to the *Phragmites*

What equipment did you use? (e.g. backpack sprayer, tractor, ATV, helicopter, other) (Drop down menu)

\[ V_{\text{fuel}}(\text{gal}) \]  How much fuel did you use in the machine?

\[ \text{Human hours (h)} \]  How much human time was spent in this treatment per type of worker? Don’t include travel time.

**Known values or constants:**

\[ \text{Cost}_\text{product} \frac{\text{USD}}{\text{gal}_{\text{product}}} \]  This is the cost of the actual product per gallon. If it was Glyphosate +, we repeat the first term of the equation for both herbicides.

\[ \text{Cost}_\text{fuel} \frac{\text{USD}}{\text{gal}} \]  Cost of fuel per equipment per gallon, by state

\[ \text{Cost}_\text{operating equipment} \frac{\text{USD}}{\text{h}} \]  According to their answer about the equipment they used, we might use set renting values for each equipment.

\[ \text{Cost}_\text{labor} \frac{\text{USD}}{\text{h}} = \text{Average wage per worker type} \]  We know how many worker hours of each category
\[ A_{\text{Proportion}} = \frac{A_{\text{MU}} \text{ (acres)}}{A_{\text{land treated}} \text{ (acres)}} \]

**Equation 1.3:**

\[
\text{Cost (USD)} = \left( \left( \text{Cost}_{\text{product}} \left( \frac{\text{USD}}{\text{gal}_{\text{product}}} \right) \times C_{\text{product}} \left( \frac{\text{gal}_{\text{product}}}{\text{gal}_{\text{mix}}} \right) \times V_{\text{mix}} (\text{gal}_{\text{mix}}) \right) + \left( \text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right) \times V_{\text{fuel}} (\text{gal}) \right) \right) + \left( \text{Cost}_{\text{rental}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours} (h) \right) + \left( \text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours} (h) \right) \times A_{\text{Proportion}}
\]

**Land manager fills out:**

\[ C_{\text{product}} \left( \frac{\text{gal}_{\text{product}}}{\text{gal}_{\text{mix}}} \right) \] % Concentration of the product (by volume)

\[ V_{\text{mix}} (\text{gal}_{\text{mix}}) \] This is how much of the mix you applied to the *Phragmites* in your MU

\[ V_{\text{fuel}} (\text{gal}) \] How much fuel did you use in the machine?

\[ \text{Cost}_{\text{rental}} (\text{USD}) \] Cost of the rental of equipment used in treatment

\[ \text{Human hours} (h) \] How much human time was spent in this treatment per type of worker? Don’t include travel time.

**Known values or constants:**

\[ \text{Cost}_{\text{product}} \left( \frac{\text{USD}}{\text{gal}_{\text{product}}} \right) \] This is the cost of the actual product per gallon. If it was Glyphosate +, we repeat the first term of the equation for both herbicides.

\[ A_{\text{Proportion}} = \frac{A_{\text{MU}} \text{ (acres)}}{A_{\text{land treated}} \text{ (acres)}} \]

\[ \text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right) \] Cost of fuel per equipment per gallon, by state

\[ \text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right) = \text{Average wage per worker type} \] We know how many worker hours of each category
2. Cut underwater

We have three situations for a “cut underwater” application on a management unit (MU):

1. The participant hired a contractor. See Equation 1.1.
2. The participant cut underwater with their own equipment. See Equation 2.1
3. The participant cut underwater with rented equipment. See Equation 2.2

Equation 2.1:

\[
\text{Cost (USD)} = \left( \left( \text{Cost}_{\text{operating equipment}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours (h)} \right) + \left( \text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours} \times (h) \right) \right) \\
+ \left( \text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right) \times V_{\text{fuel}}(\text{gal}) \right) \times A_{\text{Proportion}}
\]

Land manager fills out:

What equipment did you use? (e.g. marsh master, truxor, tractor)

\[\text{Human hours (h)}\] How much human time was spent in this treatment per type of worker? Don’t include travel time.

\[V_{\text{fuel}}(\text{gal})\] How much fuel did you put in the machine?

Known values or constants:

\[\text{Cost}_{\text{operating equipment}} \left( \frac{\text{USD}}{\text{h}} \right)\] According to their answer about the equipment they used.

\[\text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right)\] We know how many workers of each category treated the MU

\[\text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right)\] Cost of fuel per equipment per gallon, by state

\[A_{\text{Proportion}} = \frac{A_{\text{MU}} (\text{acres})}{A_{\text{land treated}} (\text{acres})}\]

Equation 2.2:

\[
\text{Cost (USD)} = \left( \left( \text{Cost}_{\text{rental}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours (h)} \right) + \left( \text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right) \times \text{Human hours} \times (h) \right) \right) \\
+ \left( \text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right) \times V_{\text{fuel}}(\text{gal}) \right) \times A_{\text{Proportion}}
\]

Land manager fills out:

\[\text{Cost}_{\text{rental}}(\text{USD})\] Cost of the rental of equipment used in treatment

\[\text{Human hours (h)}\] How much human time was spent in this treatment per worker type? Don’t include travel time.

\[V_{\text{fuel}}(\text{gal})\] How much fuel did you use in the machine?

Known values or constants:

\[\text{Cost}_{\text{labor}} \left( \frac{\text{USD}}{\text{h}} \right) = \text{Average wage per worker type}\] We know how many workers of each category

\[\text{Cost}_{\text{fuel}} \left( \frac{\text{USD}}{\text{gal}} \right)\] Cost of fuel per equipment per gallon, by state

\[A_{\text{Proportion}} = \frac{A_{\text{MU}} (\text{acres})}{A_{\text{land treated}} (\text{acres})}\]
3. Spading

Equation 3.1:

\[
Cost(USD) = \left\{ \text{Cost}_{\text{labor}} \times \left( \frac{USD}{h} \right) \times \text{Human hours } x(h) \right\} \times A_{\text{Proportion}}
\]

Land manager fills out:

\( Human \text{ hours}(h) \) How much time was spent applying this treatment? Don’t include travel time.

Known values or constants:

\( \text{Cost}_{\text{labor}} \times \left( \frac{USD}{h} \right) = \text{Average wage per worker type} \) We know how many workers of each category

\( A_{\text{Proportion}} = \frac{A_{\text{MV}} \text{ (acres)}}{A_{\text{land treated}} \text{ (acres)}} \)

4. Flooding

We have three situations for a “flood” treatment on a management unit:

1. A natural flood occurred on the management unit. No equation ($0$)
2. A passive flood was applied by the participant, with the use of gates. See Equation 3.1
3. An active flood was applied by the participant, with the use of pumps. See Equation 4.1

Equation 4.1:

\[
Cost(USD) = \left\{ \left( \text{Cost}_{\text{fuel/electricity}} \left( \frac{USD}{\text{gal or hr}} \right) \times V_{\text{fuel}} \text{ (gal or hr)} \right) \times \text{Pump hours } (h) \right\} + \left( \text{Cost}_{\text{labor}} \times \left( \frac{USD}{h} \right) \times \text{Human hours } x(h) \right) \} \times A_{\text{Proportion}}
\]

If fuel is used, volume of fuel replaces pump hours and fuel volume is multiplied by the cost of fuel per gallon

Land manager fills out:

Did you use a pump that works on diesel or electricity?

\( \text{Pump hours } (h) \) How much time was the pump on for? Or

\( V_{\text{fuel}} \text{ (gal)} \) How much fuel did you use in the pump?

\( \text{Human hours}(h) \) How much time was spent in this treatment per worker type? Don’t include travel time.

Known values or constants:

\( \text{Cost}_{\text{labor}} \times \left( \frac{USD}{h} \right) = \text{Average wage per worker type} \) We know how many workers of each category

\( \text{Cost}_{\text{fuel/electricity}} \left( \frac{USD}{h} \right) \) We will assume a set value of fuel or electricity cost per state
5. Remove biomass
We have four situations for a “removal of biomass” treatment on a management unit:

1. The participant hired a service for a burn or mechanical removal. See Equation 1.1
2. The participant removed above-ground biomass by hand. See Equation 3.1
3. The participant removed above-ground biomass using their own equipment. See Equation 2.1
4. The participant removed above-ground biomass with rented equipment. See Equation 2.2

6. Pre-flood clearing
We have four situations for a “pre-flood clearing” treatment on a management unit:

1. The participant hired a service for a burn or mechanical removal. See Equation 1.1
2. The participant removed above-ground biomass by hand. See Equation 3.1
3. The participant removed above-ground biomass using their own equipment. See Equation 2.1
4. The participant removed above-ground biomass with rented equipment. See Equation 2.2

7. Mechanical and leave
We have four situations for a “mechanical and leave” application:

1. The participant hired a service for a mechanical cut/roll/crush. See Equation 1.1
2. The participant cut/rolled/crushed by hand. See Equation 3.1
3. The participant cut/rolled/crushed using their own equipment. See Equation 2.1
4. The participant cut/rolled/crushed with rented equipment. See Equation 2.2
## Cost Constants

All costs were determined in 2018.

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