**APPENDIX 1-6: NASS Matrix of Malathion Uses**

Pesticide in Water Calculator (PWC) scenarios are developed based on general land cover classes (**ATTACHMENT 1-3: Use Footprint**) that represent potential pesticide use areas.  Malathion use sites are associated with a specific general land cover class based on which land cover best represents the use pattern[[1]](#footnote-1)[1].  Because the PWC calculator scenarios are developed for the general land covers, the land covers also determine which PWC model is used in aquatic modeling.  To develop a more spatially refined aquatic exposure assessment, aquatic modeling is conducted for each Hydrologic Unit Code (HUC) 2 Region.  These HUC2 regions are shown in the first column of the table.  To determine whether to model a use pattern for each HUC2 region, 2012 National Agricultural Statistics Service (NASS) Census of Agriculture (CoA) acreage reports[[2]](#footnote-2)[2] for the crops specific to malathion are crossed with the HUC2 regions based using ArcGIS[[3]](#footnote-3)[3].  Unless the label limits a use pattern to a particular geographic area, the National Agricultural Statistics Census of Agriculture 2012 (NASS) data were used to determine which crops would be modeled for each HUC 2 region. If the NASS data indicated any area of a crop grown (even if it was a small acreage) in a specific HUC 2 region, it is assumed that the crop is grown in that HUC 2 region and malathion is used on that crop within the HUC 2 region.  If there are no reported NASS cropped acres growing in a particular HUC 2 region, then it is assumed that the use does not occur in the HUC.  In each cell, the crop name from the NASS data label is placed for each general land cover class and HUC2 region.  For those crops/use sites where NASS harvested data are unable the crop of use site was assumed to occur within the HUC2.

Malathion uses span all general land cover classes aside from Soybeans and Pasture/Hay and many occur in all HUC2 regions.  When a specific PWC scenario does not correspond to a specific general land cover class, it is placed in No Specific Land Cover Class Identified.  The PWC calculator scenario used to model these uses patterns (e.g., clover) was the NSlandcoverESA PWCC scenario.  Through communication with growers, watercress acreage is known to be somewhat more extensive than what is reported in NASS and this is reflected in the matrix. Limited data were available for crops grown in HUC20 and 21.  More information on the assumptions used in aquatic modeling, NASS acreage, and which HUC2 regions were modeled for each use pattern is available in **APPENDIX 1-7** malathion scenario development. **Tables** **B 1-6.1** and **B 1-6.1** **2** present the NASS matrix while **Tables B 1-6.3** and **B 1-6.4** present all agricultural uses of malathion with application rate, number and interval detail.

Acknowledgement: Charles Peck developed an algorithm in excel to automatically populate this table based on NASS data and Steve Lennartz provided a cross of NASS acreage with HUC2 regions and crosswalk of the general land cover class with the malathion use sites.

**Table B 1-6.1. Malathion Specific NASS Matrix (1)**

| **HUC2** | **Corn** | **Soybeans** | **Cotton** | **Developed** | **Grassland** | **Pasture/ Hay** | **Other Crops** | **Orchards and Vineyards1** | **Watercress** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | FIELD CORN SWEET CORN | NA |  | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **2** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **3** | FIELD CORN SWEET CORN | NA | COTTON | NA RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **4** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **5** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **6** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **7** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **8** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **9** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **10** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **11** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **12** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **13** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **14** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **15** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **16** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **17** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **18** | FIELD CORN SWEET CORN | NA | COTTON | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **19** |  |  |  | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | CLOVER | CITRUS GUAVA  CHERRIES (TART) KUMQUAT |  |
| **20** | NA | NA | NA | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | NA | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |
| **21** | NA | NA | NA | RESIDENTIAL USES | ALFALFA GRASS FORAGE | NA | NA | CITRUS GUAVA  CHERRIES (TART) KUMQUAT | WATERCRESS |

1. The following Orchard and Vineyard crops can be treated with malathion: Apricots, Avocado, Chayote fruit, Chayote root, Cherries (tart and sweet), Chestnut, Citrus, Figs, Grapes (raisin, table, wine), Guava, Kumquat, Macadamia nut, Mango, Nectarines, Papaya, Passion Fruit, Peaches, Pears, Pecans, Walnuts. The highest application rate (Citrus) and lowest application rate (Guava) crops were modeled for conventional applications in each HUC to bracket EECs, while Cherries (tart) and Kumquats were modeled for ultra-low volume applications.

**Table B 1-6.2. Malathion Specific NASS Matrix (2)**

| **HUC2** | **Other Trees** | **Other Grains2** | **Wheat** | **Other Row Crops** | **Rice** | **Vegetables and Ground Fruit3** | **No Specific Land Cover Class Identified** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **2** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **3** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  PINE SEED ORCHARD  WIDE AREA USE |
| **4** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **5** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **6** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **7** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **8** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  PINE SEED ORCHARD  WIDE AREA USE |
| **9** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **10** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **11** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | no uses | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **12** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | no uses | STRAWBERRY MELONS | NURSERY  PINE SEED ORCHARD  WIDE AREA USE |
| **13** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **14** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **15** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **16** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **17** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **18** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **19** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT |  | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **20** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT | BEETS HOPS | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |
| **21** | CHRISTMAS TREE PLANTATIONS | FLAX RYE | WHEAT |  | RICE | STRAWBERRY MELONS | NURSERY  WIDE AREA USE |

1. The following Other Grain crops can be treated with malathion: Barley, Flax, Oats, Rye, Sorghum. The highest application rate (Rye) and lowest application rate (Flax) crops were modeled for conventional applications in each HUC to bracket EECs.
2. The following Vegetables and Ground Fruit crops can be treated with malathion: Asparagus, Beans, Blueberry, Broccoli; Chinese Broccoli; Broccoli Rabb, Brussels sprouts, Cabbage, Caneberries, Cantaloupe, Carrots, Cauliflower, Celery, Chinese Cabbage, Chinese Cabbage; Mustard, Chinese Mustard, Collards, Cucumber, Currant, Dandelion, Eggplant, Endive, Garlic, Horseradish, Kale, Kohlrabi, Leek, Lettuce (head), Lettuce (leaf), Melons (other than watermelon), Mint, Mustard Greens, Okra, Onion (bulb and green), Parsley, Parsnip, Peas (dry, succulent), Peppers, Potatoes, Pumpkins, Radish, Rutabagas, Salsify, Shallot, Spinach, Squash, summer, Squash, winter, Strawberry, Sweet potatoes, Swiss chard, Tomatoes; Tomatillos, Turnips (greens), Turnips (roots), Watercress, Watermelons, Yams. The highest application rate (Strawberry) and lowest application rate (Melons) crops were modeled for conventional applications in each HUC to bracket EECs.

**Table B 1-6.3. All conventional agricultural malathion uses**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Land Cover Class | Use | Rate (lbs a.i./A) | Number of applications per year | Reapplication Interval (days) |
| Corn | Corn (field) | 1 | 2 | 7 |
| Corn (sweet and pop) | 1 | 2 | 5 |
| Cotton | Cotton | 1.5 | 2 | 7 |
| Orchard/Vineyard | Apricots | 1.5 | 2 | 7 |
| Avocado | 4.7 | 2 | 30 |
| Chayote fruit | 1.75 | 2 | 7 |
| Chayote root | 1.56 | 2 | 7 |
| Cherries (tart and sweet) | 1.75 | 4 | 3 |
| Chestnut | 2.5 | 3 | 7 |
| Citrus | 4.5 | 1 | NA |
| **Citrus** | **7.5** | **1** | **NA** |
| Figs | 2 | 2 | 5 |
| Grapes (raisin, table, wine) | 1.88 | 2 | 14 |
| **Guava** | **1.25** | **13** | **3** |
| Kumquat | 4.5 | 1 | 30 |
| Macadamia nut | 0.94 | 6 | 7 |
| Mango | 0.9375 | 10 | 7 |
| Nectarines | 3 | 3 | 7 |
| Papaya | 1.25 | 8 | 3 |
| Passion Fruit | 1 | 8 | 7 |
| Peaches | 3 | 3 | 11 |
| Pears | 1.25 | 2 | 7 |
| Pecans | 2.5 | 2 | 7 |
| Walnuts | 2.5 | 3 | 7 |
| Other Crops | Clover | 1.25 | 2\* | 14 |
| Lespedeza | 1.25 | 2\* | 14 |
| Mushrooms | 1.7 | 4 | 3 |
| Other Grains | Barley | 1.25 | 2 | 7 |
| **Flax** | **0.5** | **3** | **7** |
| Oats | 1 | 2 | 7 |
| **Rye** | **1** | **3** | **7** |
| Sorghum | 1 | 2 | 7 |
| Other Row Crop | Beets | 1.25 | 3 | 7 |
| Hops | 0.63 | 3 | 7 |
| Other Tree | Christmas tree plantations | 3.2 | 2 | NS |
| Pasture/Hay | Grass (forage) | 1.25 | 1 | NA |
| Grass, Bermuda | 1.25 | 1 | NA |
| Trefoil (birdsfoot) | 1.25 | 2 | 14 |
| Vetch | 1.25 | 2 | 14 |
| Alfalfa | 1.25 | 2 | 14 |
| Rice | Rice; Wild Rice1 | 1.25 | 2 | 7 |
| Vegetables and Ground Fruit | Asparagus | 1.25 | 2 | 7 |
| Beans | NS | NS | NS |
| Blueberry | 1.25 | 3 | 5 |
| Broccoli; Chinese Broccoli; Broccoli Rabb | 1.25 | 2 | 7 |
| Brussels sprouts | 1.25 | 2 | 7 |
| Cabbage | 1.25 | 6 | 7 |
| Caneberries | 2 | 3 | 7 |
| Cantaloupe | 1 | 2 | 7 |
| Carrots | 1.25 | 2 | 7 |
| Cauliflower | 1.25 | 2 | 7 |
| Celery | 1.5 | 2 | 7 |
| Chinese Cabbage | 1.25 | 2 | 7 |
| Chinese Cabbage; Mustard | 1.25 | 2 | 7 |
| Chinese Mustard | 1.25 | 3 | 7 |
| Collards | 1 | 3 | 7 |
| Cucumber | 1.75 | 2 | 7 |
| Currant | 1.25 | 3 | 7 |
| Dandelion | 1.25 | 2 | 7 |
| Eggplant | 1.56 | 4 | 5 |
| Endive | 1.25 | 2 | 7 |
| Garlic | 1.56 | 3 | 7 |
| Horseradish | 1.25 | 3 | 7 |
| Kale | 1 | 3 | 5 |
| Kohlrabi | 1.25 | 2 | 7 |
| Leek | 1.56 | 2 | 7 |
| Lettuce (head) | 1.88 | 2 | 6 |
| Lettuce (leaf) | 1.88 | 2 | 5 |
| **Melons (other than watermelon)** | **1** | **2** | **7** |
| Mint | 0.94 | 3 | 7 |
| Mustard Greens | 1 | 3 | 5 |
| Okra | 1.2 | 5 | 7 |
| Onion (bulb and green) | 1.56 | 2 | 7 |
| Parsley | 1.5 | 2 | 7 |
| Parsnip | 1.25 | 3 | 7 |
| Peas (dry, succulent) | 1 | 2 | 7 |
| Peppers | 1.56 | 2 | 5 |
| Potatoes | 1.56 | 2 | 7 |
| Pumpkins | 1 | 2 | 7 |
| Radish | 1 | 3 | 7 |
| Rutabagas | 1 | 3 | 7 |
| Salsify | 1.25 | 3 | 7 |
| Shallot | 1.56 | 2 | 7 |
| Spinach | 1 | 2 | 7 |
| Squash, summer | 1.75 | 3 | 7 |
| Squash, winter | 1 | 3 | 7 |
| **Strawberry** | **2** | **4** | **7** |
| Sweet potatoes | 1.56 | 2 | 7 |
| Swiss chard | 1 | 2 | 7 |
| Tomatoes; Tomatillos | 1.56 | 4 | 5 |
| Turnips (greens) | 1.25 | 3 | 5 |
| Turnips (roots) | 1.25 | 3 | 7 |
| Watermelons | 1.5 | 4 | 7 |
| Yams | 1.56 | 2 | 7 |
| Watercress2 | Watercress1 | 1.25 | 5 | 3 |
| Wheat | Wheat (spring and winter) | 1 | 2 | 7 |

1 Use assessed with Pesticides in Flooded Application Model (PFAM v1.0)

2 Not a General Landcover Class; coverage determined through NASS and watercress grower group communication

NA – Not Applicable

NS – Not Specified

**Table B 1-6.4. All Ultra Low Volume malathion uses**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Land Cover Class | Use | Rate (lbs a.i./A) | Number of applications per year | Reapplication Interval (days) |
| Corn | Corn (field) | 0.61 | 2 | 7 |
| Corn (sweet and pop) | 0.61 | 2 | 5 |
| Cotton | Cotton | 1.22 | 3 | 7 |
| Orchard/Vineyard | Cherries (tart) | 1.22 | 6 | 7 |
| Cherries (sweet) | 1.22 | 4 | 7 |
| Citrus | 0.175 | 3 | 7 |
| Kumquat | 0.175 | 2 | 7 |
| Other Crop | Clover | 0.61 | 2 | 14 |
| Lespedeza | 0.61 | 2 | 14 |
| Other Grains | Sorghum | 0.61 | 2 | 7 |
| Other Tree | Christmas tree plantations | 0.9375 | 2 | NS |
| Pasture/Hay | Pasture rangeland | 0.92 | 1 | NA |
| Grass, Bermuda | 0.92 | 1 | NA |
| Rice | Rice; Wild Rice1 | 0.61 | 2 | 7 |
| Vegetables and Ground Fruit | Beans | 0.61 | 2 | 7 |
| Blueberry | 0.61 | 2 | 7 |
| Wheat | Wheat (spring and winter) | 0.61 | 2 | 7 |

1 Use assessed with Pesticides in Flooded Application Model (PFAM v1.0)

NA – Not Applicable

NS – Not Specified

1. [1] Landover by use site crosses for each chemical were provided by Steve Lennartz. [↑](#footnote-ref-1)
2. [2] <http://quickstats.nass.usda.gov/> [↑](#footnote-ref-2)
3. [3] These data were provided by Steve Lennartz. [↑](#footnote-ref-3)