Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

RAISED BEDS

CODE 812

(sf)

DEFINITION

Create an above ground growing environment.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce concentration of salts or other chemicals in the soil that limit the desired use
- Improve plant health and productivity
- Reduce field operation-induced particulate emissions within the raised bed footprint

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to land in habited areas where the desired new use of a site is for agricultural crop production and existing soil conditions are significantly impaired by poor fill material (e.g., heavy clay), non-biodegradable materials from previous use (e.g., bricks, concrete, asphalt, etc.), and/or the potential for heavy metals and other contaminants that can pose a health risk for edible crops. The raised bed(s) will be used where the existing substrate is not suitable for in-ground crop production, and it is not practical to remediate poor soil conditions.

This practice does not apply to roof top agriculture, container gardening or indoor vertical farming. This practice does not apply to aquaculture production of fish or seafood.

CRITERIA

General Criteria Applicable to All Purposes

Create beds that are 6 to 24 inches above the existing soil surface to support healthy root system development. Determine the required bed area and height by assessing the needs for spacing and rooting depth of planned crops, and preferences of the client.

Design the width of the raised bed to limit the need for stepping into or on the bed. The length of a raised bed will be based on the available space and preferences of the client.

Raised beds can be made into any shape desired.

Beds may be framed or unframed. Framing is recommended for beds that will be 6 inches tall or higher.

Framing materials must have a lifespan of at least 5 years, be free of toxic chemicals that can leach into the growing media, and be sufficiently thick and/or strong to retain the growing media for the life of the practice.

NRCS, MD
November 2022

Acceptable framing materials include:

- Wooden boards —
  - Naturally decay-resistant wood such as red cedar, white cedar, white oak, fir, locust, etc.
  - Pressure-treated lumber that is treated with chemicals that are currently registered for residential use by the U.S. Environmental Protection Agency.
  - Refer to the “Considerations” section for additional information.
- Other materials, *provided the design is evaluated and approved in advance by the State Resource Conservationist or designated state technical specialist.* These materials may include—
  - Composite (engineered) wood, vinyl boards, metal, fabric, etc.
  - Manufactured raised bed kits constructed of food-safe, decay-resistant wood or plastic.

Unacceptable framing materials include: Tires, landscape timbers, railroad ties, and methyl bromide treated pallets.

Provide growing media that is free of debris and contaminants, such as compost or a compost/clean soil mixture. Characteristics of the chosen growing media will support the needs of the plants to be grown. Prior to filling the beds, conduct a soil test of the new material that will be used for filling the beds. To the extent feasible, the growing media in the beds should be made level or nearly level to facilitate even distribution of water.

Determine the need for a root barrier between the existing soil and the growing media by evaluating the potential for plant roots to contact contaminants or debris, and the upward movement of contaminants. Assess levels of contaminants by using a portable x-ray fluorescence (pXRF) or by implementing a Site Assessment and Soil Testing for Contaminants (CEMA 207) activity. Contact a Resource Soil Scientist for assistance in determining the risks and methodology to assess the contaminants.

When a soil test shows that heavy metal contamination exceeds the safety thresholds for residential use, as defined by land grant university research and recommendations, install a heavy duty non-woven landscape fabric (e.g., 4 oz. geotextile filter fabric that allows water to pass through slowly) between the in-situ soil and the new growing substrate to reduce the exposure of plant roots to contaminants. A non-permeable barrier (e.g., 6 mil plastic sheeting) may be used if provisions are made to allow water to drain from the raised bed.

Conduct ground disturbing operations in a manner that will not compromise the structural integrity of the root barrier.

Provide designated walkways and/or travel lanes between beds with an adequate width to accommodate the needs of people and equipment.

For organic operations, it is the producer’s responsibility to ensure that all methods and materials used are consistent with USDA National Organic Program requirements for organically produced agricultural products.

Note: Specific programs may dictate criteria in addition to, or more restrictive than, those specified in this standard.

CONSIDERATIONS

Where existing soil contains construction debris material, it is possible to find elevated concentrations of salts derived from the decomposition of concrete or other materials. These conditions could produce elevated pH levels. Consider adjusting pH levels to prevent the mobility of known heavy metals and maintain optimal plant nutrient availability.

Where heavy metals are a concern, consider adding lime to the existing unsuitable soil before installing a root barrier, so that heavy metals are not in plant-available, soluble, or mobile forms in case roots penetrate the barrier.

Drainage of beds with impervious root barriers should be considered and discussed to prevent over-saturation of the growing media.

Consider the cost of framing materials and their potential longevity. Some materials can last much longer than others – for example, white oak, red cedar, locust, etc. could potentially function for 10-20 years, or longer with a plastic sheet liner.

If wood is used for framing, a 1-inch minimum thickness (nominal dimension) or 0.75-inch minimum (actual dimension) is recommended. Consider using lumber that is thicker than the 1-inch minimum. Thicker boards will withstand more wear than 1-inch boards, but will also be more expensive to purchase. Extra supports may be needed to hold 1-inch boards, so the cost-savings of 1-inch boards might be less beneficial than expected. Using 2-inch boards is especially recommended for beds that will be taller than 12 inches because the thicker boards are less likely to bow out from the weight of the growing media.

To maintain the function of the frame, connect the frame pieces with fasteners (e.g., nails, screws, corner braces, etc.) that are more resistant to corrosion than uncoated steel. Plastic materials and metals such as hot dipped galvanized steel, stainless steel, copper, or brass may be suitable.

Pressure-treated lumber is generally much less expensive to purchase than naturally decay-resistant wood. Lumber that is pressure-treated with alkaline copper quaternary (ACQ) or copper azole (CA-B, CA-C) is currently registered for residential use by the U.S. Environmental Protection Agency (EPA). Avoid older chemically-treated lumber that contains EPA restricted-use chemicals (e.g., chromated copper arsenate (CCA), creosote, or pentachlorophenol). The primary concern with using CCA-treated wood, which was commonly available until 2004, is the arsenic component that can leach into the soil, be taken up by plants, and ingested by humans in vegetable and fruit crops. Arsenic can have chronic toxic effects on humans at low intake levels. Currently approved chemicals (ACQ, CA-B, CA-C) do not contain arsenic but do contain copper, an element that is not considered toxic by the EPA. However, some copper will leach from lumber treated with ACQ, CA-B, or CA-C.

If there is a concern about using treated wood, consider adding a heavy plastic (polyethylene) liner or a polypropylene fabric liner between the treated wood and the soil of the raised bed. Side liners can also help keep soil and nutrients in the raised bed and off paths and walkways.

Consider the accessibility of raised beds and travel walkways for children and/or persons with limited or impaired mobility. Beds that are 6 to 12 inches tall are good for children. For wheelchair access, beds should be 18 to 24 inches tall.

The width of the bed should be based on the arm reach of the users. The objective is to avoid stepping into the bed while planting, maintaining, and harvesting crops. For most adults, the ideal bed width is 4 feet if the bed is accessible from both sides. For children, plan raised beds that are 3 feet wide. For wheelchair access, bed widths of 2 feet for children and 3 feet for adults are recommended.

Travel walkways 18 to 24 inches wide are recommended for general use. To provide access for wheelchairs, carts, and wheelbarrows, allow at least 4 feet between beds. Wider travel lanes will be needed if larger equipment or vehicles need access between the beds.

Cover walkways and other areas of exposed soil to reduce dust migration and splash-back onto crops and protect against human exposure while gardening. Refer to the Maryland conservation practice standard for Trails and Walkways (575) to establish hardened paths. Consider using the Maryland conservation practice standards for Critical Area Planting (342) or Mulching (484) to reduce dust emissions from small between-bed spaces.

On sloping land, compacted paths can become channels for concentrated flow of water. To minimize erosion on paths, consider the slope when laying out beds.

When growing crops that sprawl, such as cucumbers, squash, tomatoes, and melons, plant in a bed by themselves. Trellising, caging, netting, pruning, and training plants may be necessary. Consider choosing varieties of plants with compact growth habits, such as “bush” varieties.

Consider light exposure (seasonal sun angle) and shading when planting crops. In summer, it may be beneficial to use taller crops to partially shade shorter crops. However, if the shorter crops require full sun, orient the planting so that it will not be shaded by taller crops.

The producer may practice multispecies cropping, conservation crop rotation, cover cropping, and/or single species cropping. If disease carry over is a concern and crop rotation is not possible, crop residues should be removed and composted to the appropriate temperatures to avoid potential contamination of the next crop. If residues are removed, consider using cover crops to prevent erosion and/or increase soil organic matter.

Commercial growing media (e.g., “potting soil”) is often sphagnum peat-based and carbon intensive to remove and transport. Sphagnum peat-free growing media may be locally available that uses pine bark, composted leaves, parboiled rice hulls, composted peanut hulls, and other agricultural byproducts with lower carbon costs.

Consider the need for a water supply and irrigation system. Hand watering can be used, but is less feasible when there are many beds. Consider installing a microirrigation system with trickle lines on the bed surface or small overhead sprinklers.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice. The completed 812 Implementation Requirements (IR) sheet can serve as the plan and specifications for this practice.

The following items shall be addressed, as appropriate:

- Location of raised beds on the tract.
- Length, width, and height of each bed.
- Layout of beds.
- Minimum distance needed between beds to accommodate all users and equipment.
- Framing material, if used.
- Requirements for imported growing media. (Refer to Rutgers Cooperative Extension Fact Sheet FS1328, Soil for Raised Beds.)
- Root barrier material specifications, if installed between the existing soil and the new growing media.

Supporting Data and Documentation

- Location of the practice on the conservation plan map.
- Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.
- Design. Completed IR sheet. A separate sketch or design drawing that includes bed length, width, and height may be developed and attached to the IR, as applicable. When the design includes different specifications for each bed, identify the differences on the sketch/drawing. The design must also include the layout and spacing of beds. If alternative materials are used in the design, document in the case file the required review/approval from the State Resource Conservationist or

state technical specialist.

- Implementation certification. At a minimum, verify the practice as applied, including the location, extent, types of materials used, and date completed. “Red line” and initial acceptable substitutions or changes to the design. If the practice extent or location was changed, revise the practice geometry when certifying in Conservation Desktop, prepare an “As-built” map or sketch, and attach it to the IR sheet.

OPERATION AND MAINTENANCE

An operation and maintenance plan will be provided to and reviewed with the operator/landowner. The plan will include the following items and others, as appropriate.

- Monitor and maintain the height of raised beds and material within the beds.
- If framed beds are used, periodically check all frame joints and boards, and repair/replace any failures as soon as possible.
- When compost or high organic matter material is utilized as growing media, replenish material as needed to maintain the minimum of 6 inches above the surrounding surface to optimize drainage and up to 24 inches above the surrounding surface when roots must be separated from the existing soil.
- Test the soil in the raised beds every at least 3 years, or as determined by university recommendations at a minimum testing frequency for known contaminants. Annual testing for salts is recommended in high tunnels and for crops such as tomatoes that require high levels of fertilization.
- Maintain all travel and working surfaces in a smooth and graded condition, free of ruts and depressions that can collect and hold water.
- Monitor site erosion and implement appropriate conservation practices as soon as possible.
- Inspect and maintain associated surface and subsurface drainage practices to manage erosion and concentrated flows.
- If microirrigation is used, periodically inspect and repair the system as needed.

REFERENCES

Brownfields and Urban Agriculture: Interim Guidelines for Safe Gardening Practices. 2011. United States Environmental Protection Agency.

Healthy Soils, Healthy Communities: Metals in Urban Garden Soils. 2015. Cornell University.

Hettiarachchi, G.M., N.O. Nelson, S.C. Agudelo-Arbelaez, Y.A. Mulisa, J.L. Lemunyon. 2012. Phytoremediation: Protecting the Environment with Plants. Kansas State University.

Murphy, Stephanie. 2020. Soil for Raised Beds (FS1328). Rutgers Cooperative Extension.

Pettinelli, Dawn. Soil Lead Interpretation Sheet. University of Connecticut Soil Nutrient Analysis Laboratory.

Rutgers Cooperative Extension Fact Sheet FS1328. 2020. Soil for Raised Beds. https://njaes.rutgers.edu/fs1328/

Reusing Potentially Contaminated Landscapes: Growing Gardens in Urban Soils. 2011. United States Environmental Protection Agency.

Shayler, H., M. McBride, E. Harrision. 2009. Guide to Soil Testing and Interpreting Results. Cornell Waste Management Institute.

Shour, Mark. July, 2017. Toxicity Concerns about Raised Bed Construction Materials. Iowa State University Extension and Outreach. https://www.extension.iastate.edu/smallfarms/toxicity-concerns-about-raised-bed-construction-materials

Stehouwer, Richard. 2002. Environmental Soil Issues: Garden Use of Treated Lumber. Penn State Cooperative Extension. https://extension.psu.edu/environmental-soil-issues-garden-use-of-treated-lumber

University of Georgia Extension. 2019. Raised Garden Bed Dimensions. https://extension.uga.edu/publications/detail.html?number=C1027-4&title=Raised%20Garden%20Bed%20Dimensions

USDA, NRCS. 2000. Soil Quality - Urban Technical Note No. 3: Heavy Metal Soil Contamination.

USDA, NRCS. 2018. Soil Quality - Urban Technical Note No. 4: Urban Soils in Agriculture.

USDA, NRCS. 2004. Understanding Soil Risks and Hazards, Contamination by Metals (p. 17-20). https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052508.pdf

U.S. Environmental Protection Agency. Overview of Wood Preservative Chemicals (website). https://www.epa.gov/ingredients-used-pesticide-products/overview-wood-preservative-chemicals

U.S. Environmental Protection Agency. 2011. Reusing Potentially Contaminated Landscapes: Growing Gardens in Urban Soils.