Portland

ECOROOF Guide

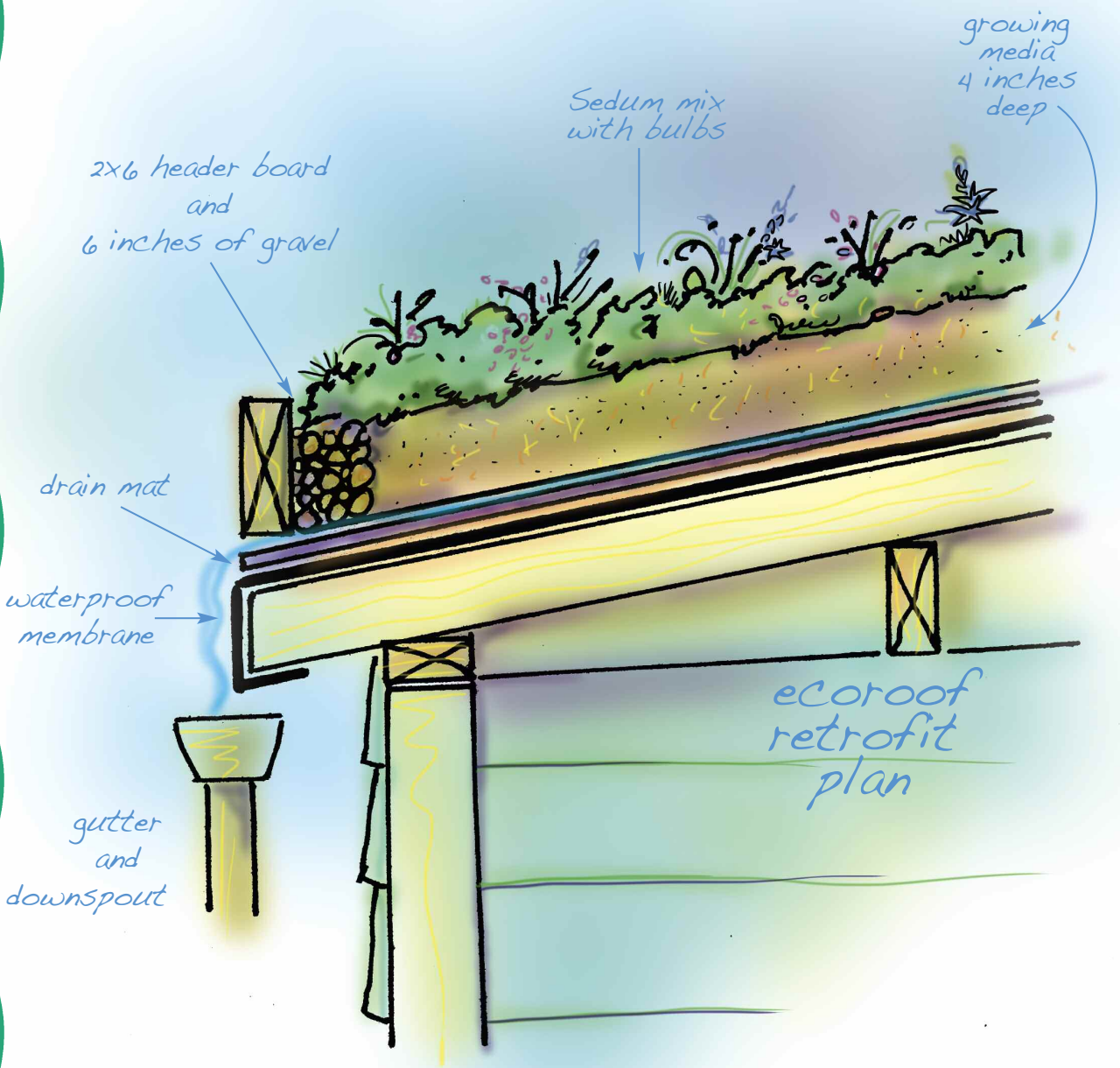

TABLE OF CONTENTS

How to Use the Portland ECOROOF Guide	3
Step 1: Determine Your Ecoroof Project Goals	4
Step 2: Determine Your Involvement	4
Step 3. Assess Existing Conditions	5
Step 4: Design, Construction Drawings and Specifications	8
Step 5: Installation and Establishment	17
Step 6: Operations and Maintenance	18
Resources	19
Appendix: Worksheets, Grid sheets, and Tables	20

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HOW TO USE THE PORTLAND ECOROOF GUIDE

The ***Portland ECOROOF Guide*** (***Guide***) has been developed with the expectation that readers are familiar with the basics of ecoroofs as presented in the *Portland Ecoroof Handbook* 2009. The ***Guide*** is organized in six steps to move you through a project, whether you're a do-it-yourselfer (DIY), project manager or a client.

Step 1 ***Determine your ecoroof project goals***
What kind of ecoroof do you want?

Step 2 ***Determine your involvement***
After making a decision about the ecoroof you want, you then need to determine if you should try to do it yourself, or act more as a project manager or hire someone else to do it.

Step 3 ***Assess existing conditions***
Assess the conditions of your structure and how it is located on your property. We encourage even the most adept DIY to get help with this step, especially the evaluation of structural capacities. You must understand the limitations and strengths of your structure.

Step 4 ***Design, Construction Drawings and Specifications***
In this step, you will design the ecoroof and make decisions about many of its components. You will obtain cost estimates based on preliminary decisions and go back and forth to decide what designs and products work best for your budget and expectations. You will prepare drawings, specifications, an establishment plan and an Operations & Maintenance (O&M) Plan regarding those final decisions. You will organize the work process, sequence and schedule. Arrange for or hire others to do some or all of the work and obtain city permits.

Step 5 ***Installation and Establishment***
Follow your plans and specifications, but be open to changes. Pay attention to safety and other issues listed in this step. Maintain the ecoroof according to your establishment plan, especially during the first two to three years.

Step 6 ***Operations and Maintenance***
Follow your plan but make adjustments as needed based on the first two to three years of establishment and enjoy.

STEP 1: DETERMINE YOUR ECOROOF PROJECT GOALS

There are many reasons to build an ecoroof. We recommend that you think about two priority issues:

❶ **What do you want the ecoroof to do and look like?** For example, do you want a simple sedum ecoroof or something with more visual diversity, edible plants, or that provides better bird or insect habitat? This Guide provides information about a simple sedum ecoroof. If you desire something more complex, we encourage you to seek professional assistance.

❷ **How much time and money do you plan to spend to construct and then maintain the ecoroof?** The more you deviate from the basic sedum ecoroof the more care and expense is likely needed to keep your ecoroof alive and working.

STEP 2: DETERMINE YOUR INVOLVEMENT

This Guide is primarily for do-it-yourselfers (DIYs), but can apply to varying roles in a project. We encourage you to review the information in steps 3-6 to help you choose your role. The following are brief summaries of the main tasks involved.

What role will you play?

DIY: If you do all the work yourself, you will:

✔ Design the project
✔ Find and purchase the materials
✔ Obtain city permits
✔ Install the ecoroof
✔ Coordinate structural and design support
✔ Obtain cost estimates
✔ Prepare the site

With DIY, you control the budget and the schedule, which gives you more flexibility but requires more organizational and technical skill. If you choose this role, move on to Step 3.

PM (Project Manager): If you manage the project and hire professionals to design and install your ecoroof, you will:

✔ Consult with designers to assure your vision and project goals are met
✔ Select and hire contractors
✔ Coordinate the scope and direction of the project
✔ Make sure your contractors are on schedule and within budget

You need only moderate technical skills to be the PM, but you should have a firm understanding of ecoroofs and experience with project management and organization to assure success. If you choose this role, move on to Step 3.

Client: If you act as the client and hire someone to do the work you will:

✔ Hire a Project Manager (PM), who then hires and coordinates contractors.

You do not need project management or ecoroof experience, but you will need to find and interview PM candidates and select the one that best suits you. This Guide can help you keep track of the project. If you choose this role, you can use the resources in the back of this document to find Portland-area consultants.

STEP 3. ASSESS EXISTING CONDITIONS

If the project is new construction, you can skip existing structure and roof conditions and start at Prepare Site Plan, page 6. For existing buildings start here:

Existing Structure

Even if you plan to build the project yourself, you'll need to consult a qualified professional to determine the weight-bearing and seismic capacity of your structure. If the evaluation shows that the building can't hold an ecoroof, you'll need a professional to determine the necessary upgrades.

Structural engineers can use existing plans to assess the building's structural capacity. They will need information about the roof, walls and foundation. They can also survey the structure and calculate the upgrades needed to support additional weight. In some cases, no structural or seismic upgrades are required for the basic 20-22 pounds per square foot (psf) simple sedum ecoroof, including all components.

Now, based on the structural information you have obtained, you can decide whether or not an ecoroof is feasible and within your budget. If you continue then go to the next item and proceed from there.

Note: all references to structural capacity are in addition to meeting the 25 psf snow load requirements of the city building code. Make sure to check with building code officials for the most current requirements. Consult the ***Ecoroof Handbook*** for some material weights.

Existing Roof conditions

Below is a list of information needed to assess your roof.

- What kind of roofing materials does your structure have (e.g. shingles or membrane)?
- How many roof layers are under the top layer?
- How much do the existing layers weigh?
- How old is the roof membrane?
- What is the condition of the roof? Look for peeling, cracking, blistering, leaking or other signs of wear that would indicate poor condition. Also check the deck and other structural materials for damage, wear, or rotting.
- What is the slope of the roof? If the roof slopes, you may need to consider methods to secure all materials firmly to the roof.
- Is there insulation? Your structure may have insulation under or on top of the membrane; above the ceiling inside the building; or there may be no insulation at all.
- If there is insulation, is it tapered to provide drainage? If so, retain or replace insulation to maintain these conditions as needed.
- Do the gutters connect to downspouts or does your building have internal drains?
- Identify vent pipes, attic vents, chimneys, skylights, and anything else on the roof that must remain. You may need to modify these fixtures to accommodate the ecoroof. continued

- Document the degree or percent of slope and aspect of the roof and drainage patterns on and off the roof. Identify valleys, crickets and ridges.
- Consider flood testing if you plan to put the ecoroof on top of the existing roof membrane.
- Measure and record the dimensions of the roof and location of the various features including access for construction and future maintenance.

Existing Roof Conditions

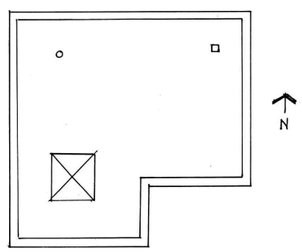
If you're unsure how to assess the condition of your roof, consult a qualified professional to help.

See Appendix: Table 3

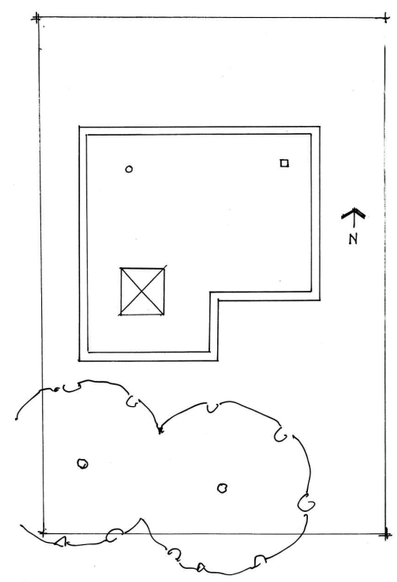
Prepare an Existing Roof Conditions Drawing

Use graph paper or a computer program to prepare a scale plan of the roof conditions you recorded. Many professionals use a 1/2 inch = 1 foot scale. Draw your roof as it exists today and include the measurements. Use the grid sheet available on page 27 to sketch your own drawing of existing roof conditions.

Existing Roof Conditions Example



Site Plan Example



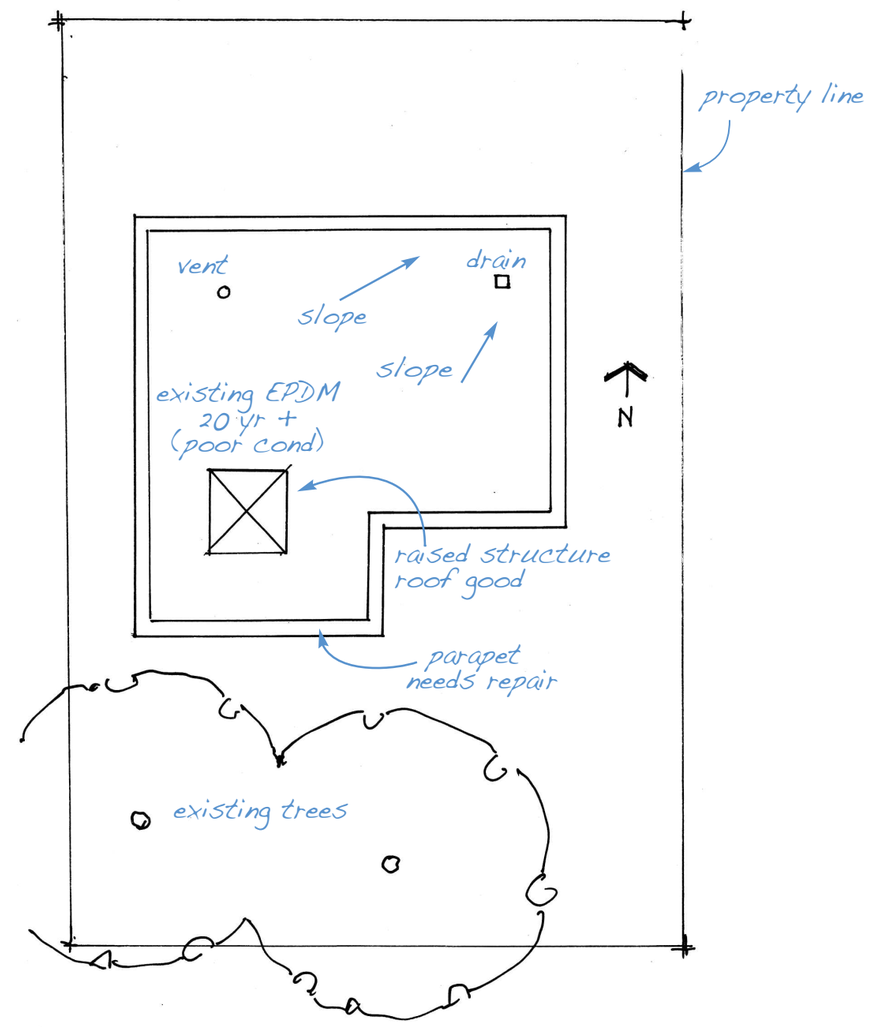
Prepare a Site Plan

Show your roof in the context of the site. If you have structural or other drawings of your building, you can use them as your base drawing. You can also print an aerial map of your property from *portlandmaps.com* or Google maps for your base drawing. On your drawing show:

- Trees (sources of excessive leaf litter)
- Shading from adjacent structures or trees
- Prevailing wind direction
- Driveways, porches and other site features that may affect the ecoroof and construction.

Use the grid sheet available on page 27 to sketch your own site map. The drawings and information you compile here can be used in step 4 and for permit submittal, if required.

Existing Site Conditions Example



STEP 4: DESIGN, CONSTRUCTION DRAWINGS AND SPECIFICATIONS

Now you will start the design and gather costs, materials, and construction information. You will determine the drawings and specifications for the work needed. Consult the ***Ecoroof Handbook*** for typical cross sections of flat roofs

New Construction

- Confirm your goals with the design team
- Prepare a concept drawing of the ecoroof plantings, access, edging and all other features; if you chose the simple sedum ecoroof, plantings will be straightforward, but you still need to address many of the details
- Discuss ecoroof weight requirements with a structural engineer and building designer
- Minimize roof penetrations from ducts, vents, and skylights
- Consider roof drainage – how does the water leave the roof and where does it end up?
- For roofs that drain to exterior gutters, make sure an overflow is provided to account for winter snow and thaw problems; you may want to provide more than the building code requires
- Try to slope the roof toward the north and east to minimize irrigation requirements
- Consult the Ecoroof Handbook for roofing material options, ecoroof options and weights, roof exposure, etc.

Waterproof membrane

A poorly installed or damaged roof membrane can leak

If your project requires a new membrane, consider hiring a roofing professional to install it.

Determining if a New Membrane is Needed on an Existing Roof

Using the information you collected in Step 3 will help you decide what to do. If you are not sure, contact a professional.

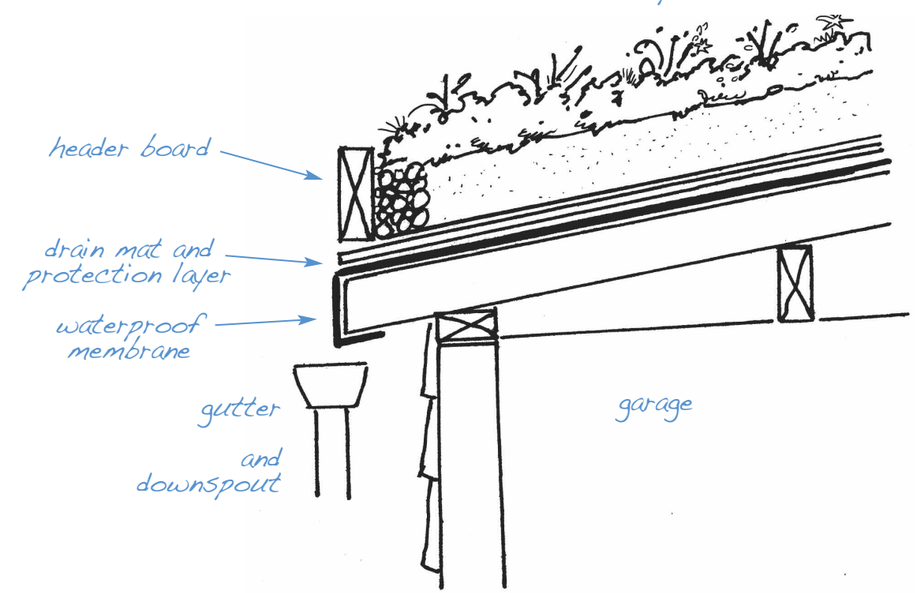
- If the existing roof membrane is in good condition, the ecoroof system may be installed directly on it. This approach is not recommended for a shingle roof.
- If the roof membrane is in fair condition or even has minor leaks, consider repairing the leaks and smoothing out any rough surfaces. Install a new membrane on top of the existing membrane, and then install the ecoroof. Flood test membrane roofs.
- If the roof is in bad condition, completely remove it and install a new membrane before installing the ecoroof. Call Metro at 503-234-3000 about construction waste recycling and disposal.

Selecting a New Membrane for New or Existing Buildings

There are many types of membranes available. For a small project and for the true DIY, a local hardware store may have a suitable membrane material. EPDM and TPO membranes do not require a root barrier for the basic sedum ecoroof, are relatively easy to install and are readily available.

Take into account the various penetrations, edges and other roof features that relate to selecting and installing the membrane. Contact roofing professionals or membrane manufacturers to get assistance with membrane selection and installation. See Table 4a for help selecting a membrane and installer.

Structure and Membrane Cross-Section Example



Insulation

Your structure may have insulation under or on top of the membrane; above the ceiling inside the building; or there may be no insulation at all. Be sure to protect existing insulation during construction. Depending on the size of the project, the city may require you to upgrade your insulation to meet current building code. The roof may also need to be vented, so consider this when consulting with professionals. If you do not have insulation, or your insulation needs replacing, there are many products available at building supply stores.

Root Barriers

Some types of membranes require a root barrier and some do not. A membrane on a modified bitumen roof, for example, needs a root barrier. Check with the membrane manufacturer to verify if it requires a root barrier. In addition, there are various root barriers on the market that are made with herbicides or metals (such as copper). The City of Portland prohibits the use of these products unless the manufacturer can prove the chemicals do not leach out over time. Thin layers of plastic sheets make good root barriers for the simple sedum ecoroof.

Membrane Protection

Cover the membrane to protect it during construction. Insulation, drainage layers, moisture mats, and recycled carpeting make good protection materials. If these materials are damaged in the process, however, they may need to be replaced.

Drainage

The slope of the ecoroof and composition of the growing media will affect the horizontal drainage across the roof. You want the ecoroof to drain, but you also want the growing media to soak up and retain precipitation to manage stormwater runoff and provide moisture for plants. The industry usually recommends using a manufactured drainage mat. Some projects use very porous growing media or a gravel layer under typical growing media. Smaller projects, such as garages on relatively flat slopes, often do not need a drainage mat. However, the mat can also function as a protection material for small and large projects. Check roofing and building supply stores for drainage mats. Consult the Ecoroof Handbook for typical cross-sections for flat roofs

Downspouts and Overflows

If your building has a parapet and the opening for drainage off the roof is small, consider enlarging it beyond current building code requirements. A small opening could get clogged with leaves or snow.

Moisture Mat

These mats retain moisture and can also protect the membrane. Recycled materials, such as carpeting, have been used in some projects. Check roofing and building supply stores for moisture mats.

Growing Media

Ecoroof growing media, or soil, should retain rain and detain runoff, provide a lasting substrate for plants, and protect the roof membrane. Ecoroof soil needs to be engineered or mixed to meet these goals. Several local companies provide ecoroof soils. When choosing any materials, carefully compare product performance and cost.

Media Weight

Determine the maximum depth of soil the structure can hold based on the structural evaluation and soil weight-to-depth ratio you obtained from soil suppliers you have contacted. Typically, 4 inches of saturated media will weigh 20 psf, but weights vary from one product to another.

For example, if your structure can hold a total load of 22 psf, you'll need to determine how much soil can be added to the other components. Subtract the weight of each item, including the membrane, membrane protection, moisture mat, drainage mat, etc, to determine the capacity available for your soil. For example: 22 psf – 2 psf (total weight of other components) = 20 psf remaining for growing media.

Types of Growing Media

Proprietary

Soil providers sell an array of products. Some companies do not disclose ingredients, but generally the products contain light weight aggregate such as pumice (in our region), compost and other materials. Saturated weights may vary with each vendor so make sure to check.

Mix Your Own

Aggregate and organic materials are available at landscape rock stores, plant nurseries and hardware stores. For a well-draining soil, consider a mix of 75% inorganic/aggregate and 25% organic, i.e. aged compost. Keep in mind that high organic content soils usually shrink.

Backyard Soil

Another approach is to use the soil in your own backyard, although garden soil is much heavier at about 10 psf per 1 inch depth. At that weight, the maximum soil depth would be 2 inches for a roof with a 20 psf capacity. A thinner soil layer retains less water, which reduces the stormwater management benefits and makes it harder to keep plants alive without irrigation. But sedums can survive with little or no irrigation if the ecoroof is partially shaded in summer.

Whether mixing your own growing media or using the soil in your backyard
confirm that its weight when saturated will not exceed your structure's capacity
A typical ecoroof soil will weigh about 5 psf per 1" depth.

If you are not mixing your own growing media, calculate the quantity of soil needed before contacting soil suppliers. At this phase you only need a preliminary calculation until you get the exact weight of the product you want.

Determine how you will get the soil up to the roof, i.e. buckets, bags, blower truck, etc. Some companies will deliver the soil in bags. There are many options, and you should choose one when preparing your specifications.

See Appendix: Tables 4b for help selecting growing media and supplier.

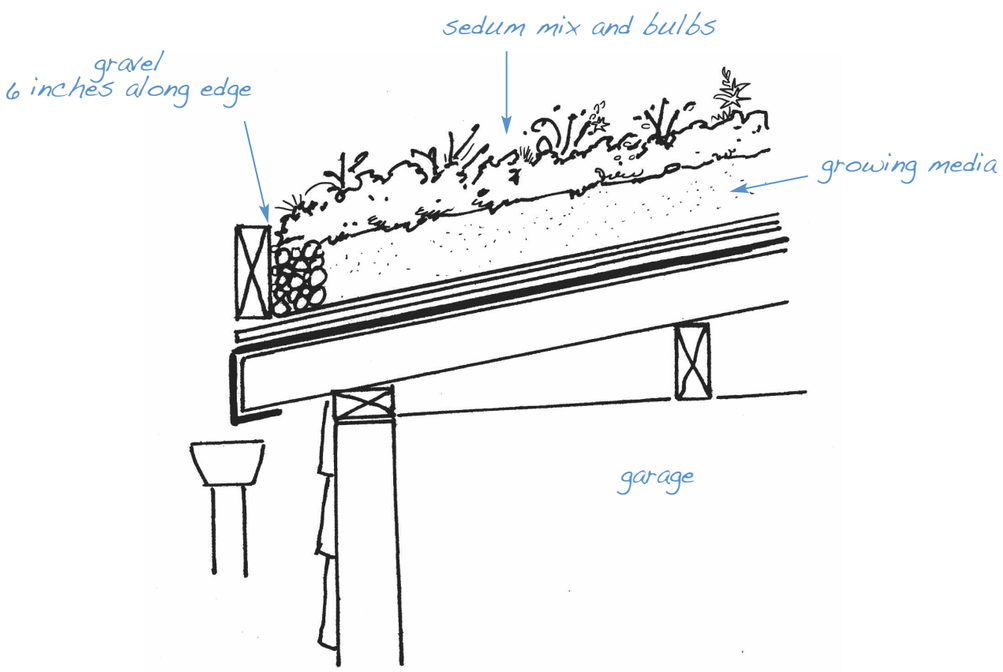
Vegetation

The best ecoroof plants require minimal maintenance and irrigation, and cover the roof quickly. The shallow soils provide habitat for a number of vegetation types, particularly certain succulents, grasses, and perennials.

Diversity of plant species can improve the resilience of the vegetative association and help ensure a healthy ecoroof. Consider a simple sedum ecoroof and include a few grasses and perennials which can act as nursing plants for the succulents.

There are hundreds of species of sedum and scores of other succulents available. The plants listed here grow well in shallow ecoroof soils and in some cases with very little or no irrigation. If you want to test different plants on your ecoroof, test in small areas or mix with your staple plants.

Planting Cross-Section Example



Sedums

- Sedum acre (se)
- Sedum album (e) many varieties
- Sedum divergens (e) - native
- Sedum hispanicum (se)
- Sedum kamtschaticum (d) many varieties
- Sedum oreganum (e) - native
- Sedum rupestre (e)
- Sedum sexangulare (e)
- Sedum spathulifolium (e) - native many varieties
- Sedum spurium (d) many varieties
- Sedum telephium Autumn Joy (d)

plant type:
(e) evergreen
(se) semi-evergreen
(d) deciduous

Non-sedums

- Sempervivum tectorum (e) many varieties
- Camassia quamash (d) – native bulb (blue flower)
- Delosperma cooperi (e) many varieties
- Delosperma nubigenum (e)
- Festuca glauca (e) many varieties
- Muscari spp. (d)
- Polypodium glycyrrhiza (fern) - native/shade (d)
- Many native herbaceous annuals and perennials (e) (se) (d)

See Appendix: Table 4c for help selecting plants and creating a planting plan

Determine the Planting Method(s) and Establishment Procedures

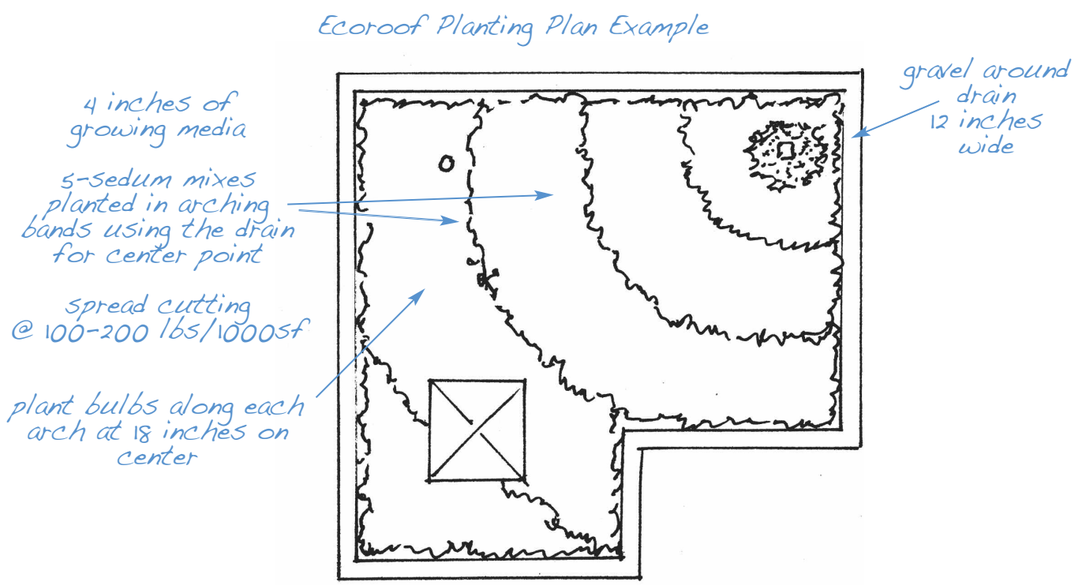
There are many ways to plant an ecoroof and sometimes it may be advantageous to use several methods for one project. Establishment procedures are similar to maintenance except they are usually more comprehensive, frequent and important. The new ecoroof needs time to become a true living unit and as such care of the plantings is more critical. Once established the system can almost maintain itself and only needs minimal care.

If possible, plant in early fall when the rains start and no irrigation will be needed until almost mid-summer. If you plant in spring or summer in Portland, you will need to irrigate. If you use potted plants, triangular spacing requires more plants but can reduce erosion and result in faster coverage. Use the following table to determine which method to choose.

Selecting the Plants

Start with ten sedum species and any number of non–sedum plants. Try to include at least 50% evergreen sedum species. If the plants you're searching for aren't available, ask the nursery for a good substitute. For more custom designs, you may need professional assistance. Methods of installation may also affect your plant selection and quantity needed. For greater biodiversity, add a few small logs (4" diameter x 18" long) or a couple of small mounds of rocks or soil (about 6" high).

Do not exceed weight capacity



Irrigation

In Portland, infrequent summer rains may not be sufficient to keep a sedum ecoroof alive during the hottest time of the year. However, some ecoroofs can survive in Portland with little or no irrigation. For a simple sedum ecoroof with four inches of soil:

- If your roof aspect is north or east, you probably do not need to irrigate in summer except during extreme or prolonged dry weather, i.e. 40 days of no rain, depending on temperatures and cloud cover.
- If your roof aspect is south or west, the solar exposure is more intense and you will likely need irrigation from mid-June to mid-September. Apply about 1/4 inch of water every 10 days. Double that amount during a heat wave.
- Shaded ecoroofs with south or west aspects may need little or no irrigation.
- Irrigate your ecoroof plants when you install them.

Irrigation Systems

Consider installing a simple irrigation system, especially to help establish plants after installation. If you decide to add plants later that need irrigation, you won't have to disturb the existing plants. You can use an automatic timer to activate your irrigation system, or turn it on manually.

You don't need a permanent irrigation system if you can easily irrigate your ecoroof with a hose and nozzle from the ground.

Automated systems can run without you being there, but if there's a malfunction it may take some time for you to notice it. Irrigation systems will probably require more maintenance than the rest of your ecoroof. Flow meters can be installed to help you understand how much water is being applied. On larger projects you can set up a deduct meter with BES. Contact the BES Submeter Coordinator at 503 823-7856 for information.

Additional Considerations

Erosion, Wind and Rain

Good vegetation coverage is the best way to prevent erosion. Until the plants are established, you can cover the media with erosion fabric, jute matting, compost, or a thin layer of coarse pumice. Many of these techniques are affected by the planting method you choose. Again, do not exceed your weight capacity. For example, if you use a 1 inch layer of cinder as mulch you will probably need to reduce your soil depth by that same amount. Jute is so light that its weight would likely be negligible.

Roof Slope / Pitch

Soil can slide or move on sloped roofs. Installing a lattice to hold the soil in smaller sections can reduce slippage. It is best to get professional help designing an ecoroof for a sloped roof (2:12 or 15% or more).

Prepare Operations & Maintenance Plan

Make sure to prepare your Operations and Maintenance (O&M) plan to address specifics about your ecoroof. Your plan may be used for permit submittal, if required.

Construction Drawing and Specifications

New construction drawings, details and specifications will all be done by the consultants. For existing buildings, prepare as much as you can to help yourself and others understand exactly what is planned. We recommend you prepare the following materials:

- existing conditions drawing and structural capacity
- cross-section of existing roof and proposed ecoroof design
- site plan, showing where the roof drains
- proposed ecoroof plan (planting plan, roof slope, drain location, etc.)
- structural information with proposed new weight, and calculations showing the capacity of the new structure
- partial list of what will be required at the time of permit submittal

Document your Progress

Use photos and a written narrative to keep track of the process as you go. It can become an invaluable record of what was done where, what was (or needed to be) modified, and how. Photographs especially will help you locate anything now obscured or hidden by your ecoroof. And, if your planting is complex, a chronicle over one or two seasons will give you a better idea of what will work best in your situation, what plants need to be managed and how, and even what you might try next.

Construction Bids

If you're not building the ecoroof yourself, you can use the information you've gathered and the plans and specifications you prepared to solicit bids from contractors. Remember that the lowest price isn't always the best bid.

- Give each bidder the same information upon which to base their bid.
- Get references and visit past project examples for each bidder.
- Ask for a construction schedule.
- Give prospective bidders a specific date to return the bids and then compare.

Prepare Permits

After you complete the design, drawings, specifications, and O&M Plan, the next step is to apply for city construction permits.

Try to allow two months before you actually want to start work

Call 503-823-7300, or visit the Portland permit center at 1900 SW 4th Avenue for more information. Ecoroofs under 200 sf may not need a permit, but check with the Bureau of Development Services (BDS) to make sure. Make sure your contractors are properly licensed with the state.

STEP 5: INSTALLATION AND ESTABLISHMENT

An ecoroof takes time to mature and the first three years require more attention to weeding and watering than the long term. Below are some additional things to consider during the installation and establishment phases.

Safety First

Make sure you protect yourself, your helpers and neighbors while working on your project. Use ladders, scaffolds and harnesses safely. Let your immediate neighbors know about your project.

Be Prepared

Gather materials, products, and equipment you need. Finalize your schedule, obtain permits and arrange for any assistance you are getting before starting the project.

Time of Year

Doing carpentry, roofing and irrigation work during late spring and summer allows you to work during the long days. Install the soil and plants in late summer to late autumn.

Construction Sequence

1. Demolition - This may include removing or repairing the existing membrane and structural items. Keep a tarp handy to protect the building from rain after demolition. Call Metro at 503-234-3000 for information about construction debris recycling and disposal.

2. Material Delivery and Storage - Arrange to have the materials and tools you will need delivered or pick them up. Set aside a storage area on your site.

3. Soil and related materials installation - Have the materials delivered or pick them up and place them in the on-site storage area. Install the soil and smooth it out carefully. Measure the soil depth to make sure the soil has been installed correctly and that you will not exceed your weight limit. To measure soil depth, mark a blunt stick, e.g. a chopstick, at one inch intervals. Test the depth in several places to make sure your soil is accurately leveled.

4. Planting - Arrange for materials delivery or pick up and place in the on-site storage area. Determine in advance how you will get the plants up to the roof, e.g. buckets, bags, cuttings, pots, seeds, mats, or bulbs. Install plants in the manner you determined in your planting design. Water carefully to moisten soil before planting. Install plantings and mulch as planned. Water plantings after installation and continue watering as needed until fall rains begin.

5. Final inspections - Do your own inspection to see that everything is in place as planned. Arrange any final inspections by the city as required.

Establishment

6. Assign an ecoroof maintenance manager

7. Irrigate as needed - This is necessary during the first three years to establish plantings. South and west exposures will dry out first. Do not over irrigate. If you see water running off, then reduce the duration of irrigation but irrigate more often.

8. Maintain irrigation systems - Make sure they are properly winterized and check that pipes are secure and not leaking.

9. Remove weeds monthly - Weed before they go to seed or as needed the first three year. Avoid weeding small new weeds as too much disruption will damage your plantings.

10. Avoid walking on the plantings - Soil compaction and plant damage will result.

11. Watch for erosion or disturbance - There can be disturbance by birds, cats, and squirrels. Once plantings are established, they can easily withstand these intrusions.

12. Keep drains clear

13. Enjoy

STEP 6: OPERATIONS AND MAINTENANCE

Long Term Maintenance

- Assign an ecoroof maintenance manager.
- Follow your O&M Plan, but modify it from what you learn during the first three years.
- Be adaptable to change.
- Check your drains each time you weed or water the ecoroof. Over time, some drains can also become clogged by moss growing in the holes of perforated metal.
- Adjust irrigation time clocks for conditions.
- Make sure irrigation systems are properly winterized and check that pipes are secure and not leaking.

See Appendix: Table 6 for an O&M Plan Example

RESOURCES

Available on the City of Portland Ecoroof Website:

www.portlandonline.com/bes/ecoroof

- Ecoroof FAQ
- Ecoroof Handbook
- Ecoroof Resource List
- Ecoroof Project Reports

Organizations

Greenroof Information Think-tank
www.greenroofthinktank.groupsite.com

Greenroofs.com: The Green Roof Industry Resource Portal
www.greenroofs.com

Green Roofs for Healthy Cities
www.greenroofs.org

Contacts

Bureau of Environmental Services
Ecoroof Program
503-823-7740

Bureau of Development Services
Permits Office
503-823-7300

Green Building Hotline
503-823-5431

APPENDIX: WORKSHEETS AND TABLES

Table 3 - Existing Conditions Worksheet	Data/Comments
What is the size of your roof?	
What kind of roofing materials does your structure have (e.g. shingles or membrane)?	
How many roof layers are under the top layer?	
How much do the existing layers weigh?	
How old is the roof membrane?	
What is the condition of the roof? Look for peeling, cracking, blistering, leaking or other signs of wear that would indicate poor condition. Check the deck and other structural materials for damage, wear, or rot.	
What is the slope of the roof? If the roof is sloping, you may need to consider methods to secure materials firmly to the roof.	
Is there insulation? Your structure may have insulation under or on top of the membrane; above the ceiling inside the building; or there may be no insulation at all.	
If there is insulation, is it tapered to provide drainage? If so, retain or replace insulation to maintain these conditions as needed.	
Do gutters connect to downspouts or internal drains?	
Identify vent pipes, attic vents, chimneys, skylights, and anything else on the roof that must remain. You may need to modify these fixtures to accommodate the ecoroof.	
What is the degree or percent of slope and aspect of the roof and drainage patterns on and off the roof? Identify valleys, crickets and ridges.	
Measure and record the dimensions of the roof and location of the various features including access for construction and future maintenance.	

Table 4a: Membrane Worksheet

Use the following questions to evaluate your options. Document this information for use in discussions with providers.

Evaluate Membrane Options

	Data/Comments
What is the condition of the existing roof membrane?	
Does the membrane need a root barrier or protection board?	
Will there be foot traffic on the roof during construction?	
Will the membrane need a protection layer?	
Additional comments:	

Select a Membrane Provider

Contact providers and use the following table to track cost estimates. Once selected, transfer the information to the project cost sheet in table 4e.

Company/Product	Warranty	Unit Cost (per s.f.)	Area Needed (s.f.)	Subtotal Unit cost x # s.f.	Delivery Fee	Total Cost

Table 4b: Growing Media Worksheet

Use the following questions to evaluate your options. Document this information for use in discussions with providers.

Evaluate Growing Media Options	Data/Comments
What is the total area of the ecoroof in your design?	
What is the depth of the growing media in your design?	
What is the weight-bearing capacity of your structure (from Step 3)	
What is the quantity of growing media needed? (calculate in cubic ft or cubic yds)	
What is the maximum weight of your growing media per cubic foot?	
Additional comments:	

Select a Growing Media Provider

Contact providers and use the following table to track cost estimates. Once selected, transfer the information to the project cost sheet in table 4e.

Company/Product	Warranty	Unit Cost per cubic yard (c.y.)	Volume Needed (c.y.)	Subtotal Unit cost x # c.y.	Delivery Fee	Total Cost

Table 4c: Vegetation Worksheet

Use the following questions to evaluate your options. Document this information for use in discussions with providers.

Evaluate Vegetation Options	Data/Comments
What time of year do you plan to install the ecoroof?	
What amount is needed to plant for maximum vegetation coverage?	
How important is it to have plants that are immediately established?	
How much control do you want in the design of your ecoroof?	
How will the plants get delivered to the project site?	
Additional comments:	

Select a Vegetation Provider

Contact providers and use the following table to track cost estimates. Once selected, transfer the information to the project cost sheet in table 4e.

Company/Product	Warranty	Unit Cost per plant	Plants Needed (per s.f.)	Subtotal Unit cost x # s.f.	Delivery Fee	Total Cost

Table 4d: Irrigation Worksheet

Use the following questions to evaluate your options. Document this information for use in discussions with providers.

Evaluate Irrigation Options	Data/Comments
Do you need an irrigation system?	
Are you willing to irrigate by hand? If so, you can leave this table blank.	
Are you able to access the roof?	
How far away is the source of water from the ecoroof?	
What are the gallons per minute (gpm) of the water source?	
What is the water pressure (psi) from the source?	
Additional comments:	

Select an Irrigation Provider

Contact providers and use the following table to track cost estimates. Once selected, transfer the information to the project cost sheet in table 4e.

Company/Product	Warranty	Unit Cost (per s.f.)	Irrigation Area (s.f.)	Subtotal Unit cost x Area	Delivery Fee	Total Cost

Table 4e: Final Cost Estimate Worksheet

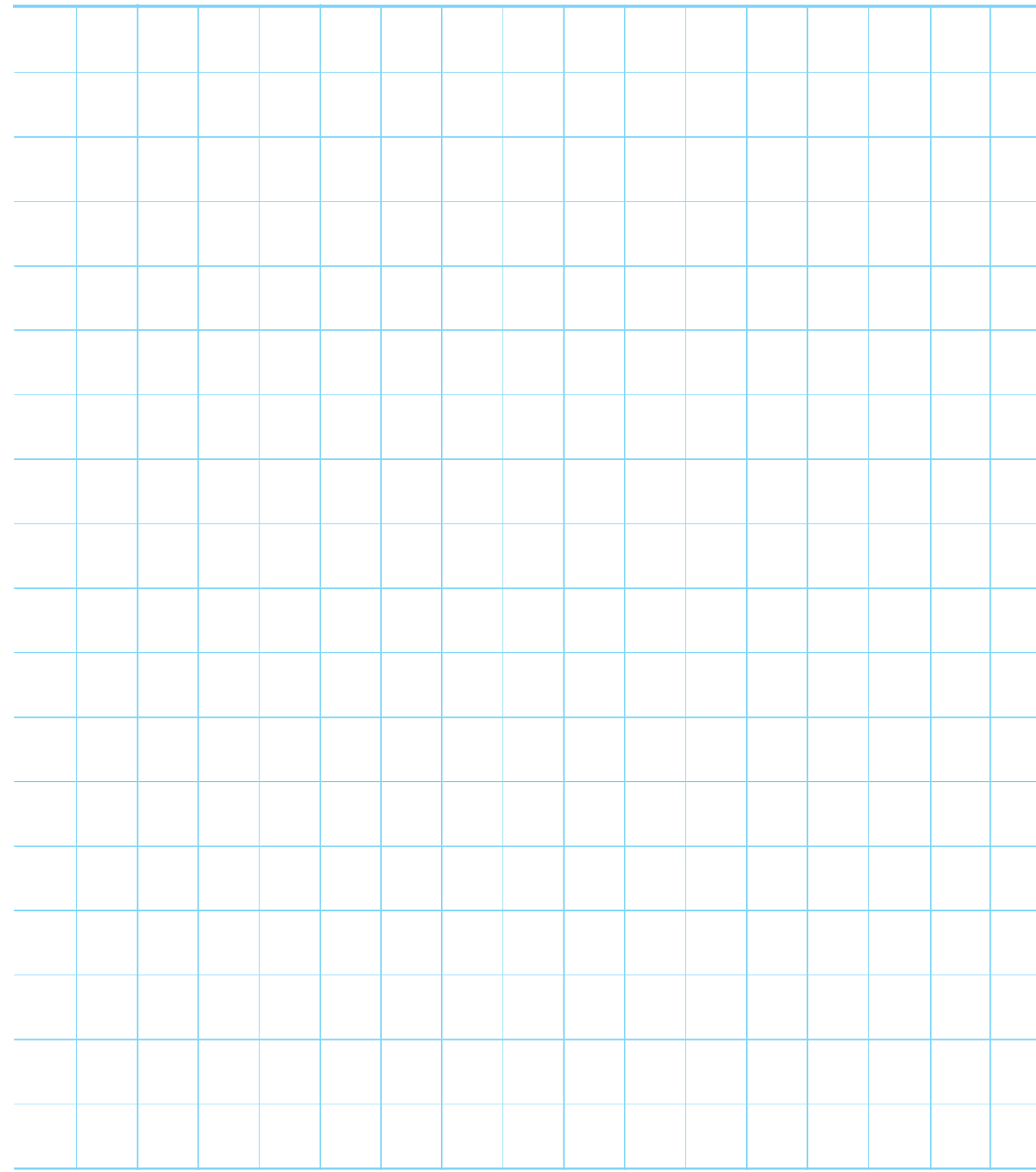
Use this sheet to keep track of your costs as you finalize details.
You can also use this sheet if you plan to hire a design/build company or firm that will provide the ecoroof project in its entirety.

Ecoroof components	Supplier	Quantity	Unit type	Weight per s.f.	Unit cost	Labor cost	Delivery Cost	Total cost
Membrane								
Root barrier (if needed)								
Drain mat (if needed)								
Drainage Channel (if needed)								
Protection board (if needed)								
Growing media								
Tray/mat (if needed)								
Gravel or paver paths (if needed)								
Edging (if needed)								
Irrigation system (if needed)								
Other								
Total Costs								

Table 6 - Example O&M Plan

Component	Maintenance
Access	Access shall be kept clear of obstructions
Aesthetics	Address as originally designed or subsequently desired
Debris	Put vegetation debris in compost bin. For large projects, consider a compost bin on the ecoroof. Remove flammable materials, like dry grass. Remove litter as needed, including heavy leaf litter from adjacent trees that could smother sedums. If the debris is not a hazard, you may let it be and break down into the ecoroof.
Drainage system	Keep drains clear. Check at least twice a year.
Fertilizer	A simple sedum ecoroof is self-fertilizing. No additional fertilizer is needed.
Insects	Most insects on ecoroofs are beneficial. Do not spray with pesticides. Lots of irrigation may attract pests, so keep it to a minimum.
Irrigation	Water as planned or as necessary to ensure the survival of the vegetation. Environmental Services recommends no more than 1/4" every 10 days maximum. Adjust irrigation time clocks for conditions. Make sure irrigation systems are properly winterized and check that pipes are secure and not leaking. If a deduct meter was installed, make sure to check it and report to get the credit.
Soil (growing media)	Inspect for evidence of erosion and correct as needed.
Standing water	Standing water on the ecoroof indicates a problem with the roof drains and/or structure. Get professional advice.
Vegetation	Inspect the health of the vegetation. Remove undesirable dead plants. Many plants can be simply left to decompose on the ecoroof. Plant additional vegetation to replace removed plants; fill in sparse areas and/or mulch to control erosion. Weed manually. Don't use pesticides. Trim seasonal grasses and perennials to prevent from becoming a fire hazard.

Grid sheet for existing conditions drawing. **scale: 1/2 inch = 1 ft**



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