CHAPTER 3 – SURVEY OF GEOSYNTHETICS USE

In tandem with the literature review, a survey was created to gauge the current level of geosynthetics usage in FLHD Projects. The survey included questions regarding the number of projects and types of applications in which geosynthetics were used, the specifications and types of geosynthetics used, and descriptions of the respondent's experiences with geosynthetics on projects, both positive and negative. Roadway applications listed in the survey included frost heave, separation, edge drains, rehabilitation and subgrade reinforcement of paved roads, new construction and rehabilitation of unpaved roads, and shoulder patches. Geotechnical/structural applications included conventional (i.e., unreinforced) retaining walls, MSE walls, soil and rock slopes, embankments, drainage, construction platforms and reinforced shallow foundations. A copy of the questionnaire is included in Appendix A.

The survey was initially sent to 18 individuals identified by FLHD, of which three had USFS e-mail addresses, and 15 had FHWA e-mail addresses. The individuals surveyed were selected by FLHD personnel to represent a cross section of FLHD practice across the three divisions, as well as a small sample of Forest Service practice. These individuals were geotechnical and pavement design, construction and field engineers. The response rate for the survey was 61% (11 returned surveys). Of these 11, one was from a USFS e-mail address.

A large majority of survey respondents (10 of 11) reported using geosynthetics in construction projects. Of these ten, four reported seeing projects with geosynthetics once a year or less, and four reported two to ten projects with geosynthetics per year. The remaining two respondents reported more than ten projects per year.

APPLICATIONS

Figure 1 and Figure 2 show pavement and geotechnical applications, respectively, in which the respondents were involved in the design or construction. In these figures, the hatched bars show the approximate number of projects that included geosynthetics. For example, for newly constructed unpaved roads, eight respondents reported being involved in such a project, while two of those eight respondents reported being involved in a new unpaved road project that included geosynthetics (Figure 1).

Roadway Applications

From Figure 1, the majority of the 11 respondents indicated being involved in the design of all the applications listed in the survey. The applications that respondents were most likely to be involved with the design were related to edge drains and separation (nine of 11), followed by subgrade reinforcement for paved roads, unpaved road rehabilitation and new unpaved road construction (nine of 11). Geosynthetic usage was most common for subgrade reinforcement of paved roads and deep patches for soft shoulders. In these two cases, all respondents who said they were involved with these applications also reported projects where geosynthetics were used.

The roadway applications on which respondents reported using geosynthetics least were new unpaved road construction (two of 11) and asphalt overlays for paved roads (two of 11). Frost heave mitigation also showed low reported usage of geosynthetics (three of 11).

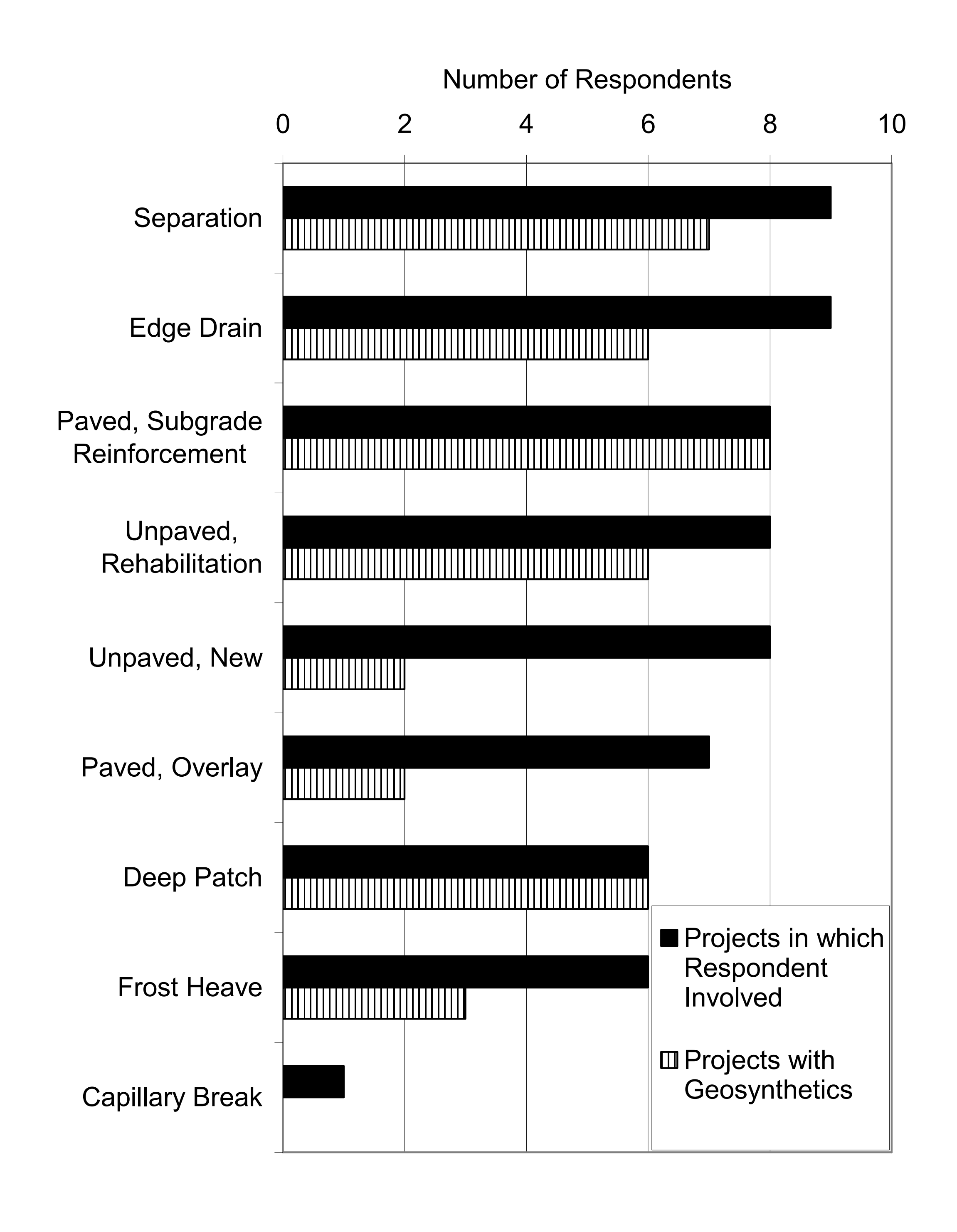

Figure 1. Graph. Roadway Applications.

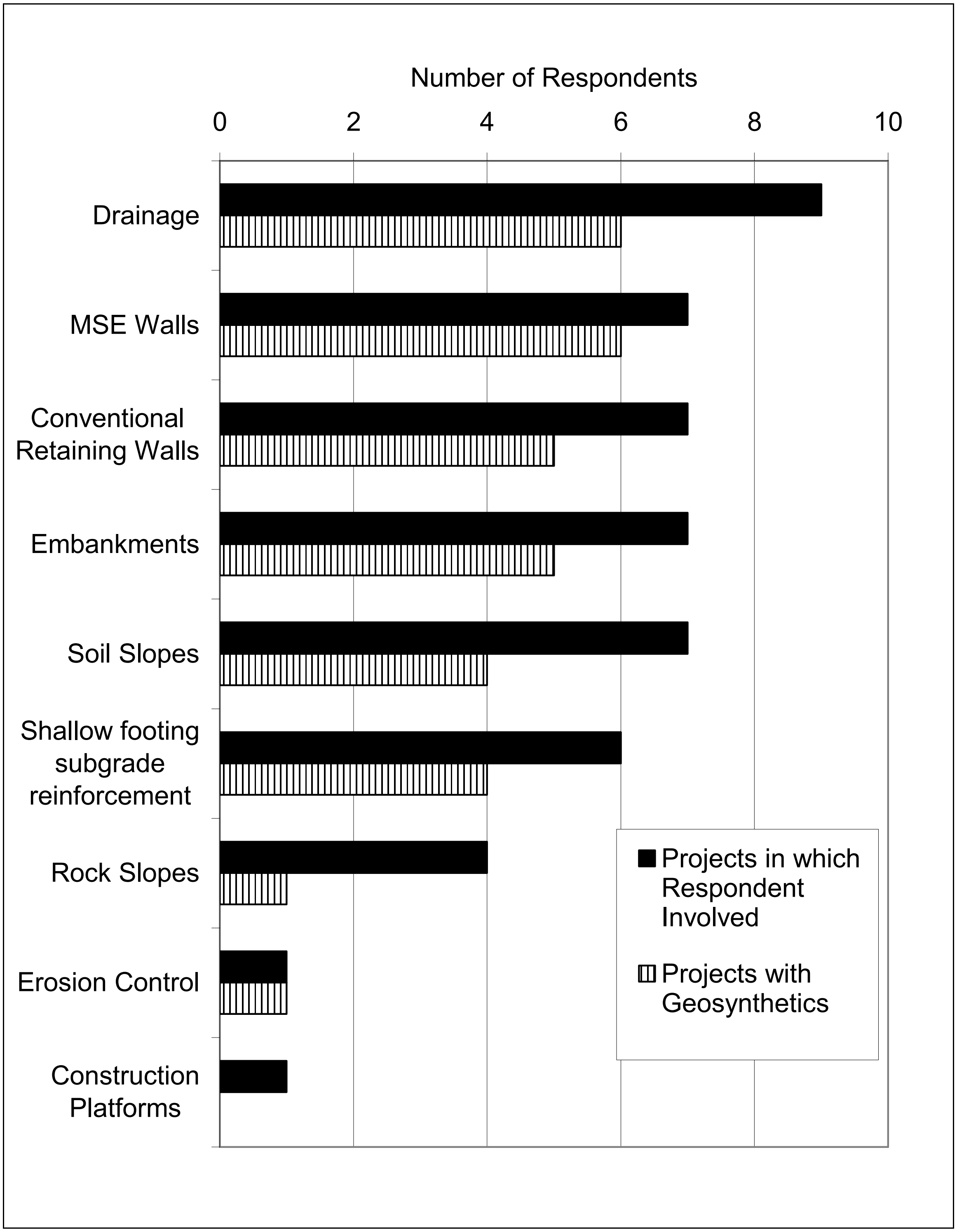

Figure 2. Graph. Geotechnical Applications.

Geotechnical Applications

In the geotechnical applications shown in Figure 2, the most reported application was drainage (nine of 11), followed by MSE walls, conventional retaining walls, embankments and soil slopes (seven of 11). Construction platforms (one of 11) received the smallest response. This may well be because reinforcement of construction access platforms is often left to contractors to implement and design (as mentioned in Perkins et al. 2005) or it may simply be a difference in terminology—to the respondents, a construction platform may be synonymous with subgrade reinforcement or new unpaved road construction.

Geosynthetic usage was most commonly reported for MSE walls (six of 11) and drainage applications (six of 11). Slopes (soil and rock) had the lowest number of respondents reporting geosynthetic usage. In absolute numbers, shallow foundation subgrade reinforcement also had four of 11 respondents reporting geosynthetic usage, but this represents 2/3 of the respondents who said they were involved with design of shallow foundations without reinforcement.

Most Common Types of Projects and Selecting When to Use Geosynthetics

When asked which of the applications in Figure 1 and Figure 2 were most commonly used by the respondent's agency, no single application was overwhelmingly reported. Five respondents reported drainage applications were most common. Retaining walls, MSE walls, slopes and separation were each noted by three respondents. A number of other applications listed in Figure 1 and Figure 2 were noted by one or two respondents only. Figure 3 summarizes the applications identified as most common.

When asked what leads to geosynthetic usage in a project, most respondents cited cost savings or improved performance for a specific application. Others noted improved constructability or specific site conditions, such as soft subgrade soils. Perhaps referring to the requirement in Holtz et al. 1998 that geosynthetic reinforcement in permanent (paved) roadways cannot reduce the base course thickness, only the stabilizing layer thickness, one respondent shed some light on why the use of geosynthetics may be hindered in permanent unpaved road construction applications:

> "During cost comparison, the paving options with geogrids generally lose out to more economical design. Only a couple of designs that were recommended have incorporated geogrids or separation fabrics. Geogrid still requires 6 inches of base on top of the geogrid, and height can be an issue on mountain roads."

Finally, all respondents reported using geosynthetics in permanent installations. Six of 11 respondents said their agency uses geosynthetics in temporary construction, or structures lasting up to three months. Five of 11 respondents reported geosynthetic usage in installations that would last up to two years. Thus, it would appear that concerns over geosynthetics long term performance have been at least partially satisfied, at least if all respondents are reporting geosynthetic usage in permanent structures.

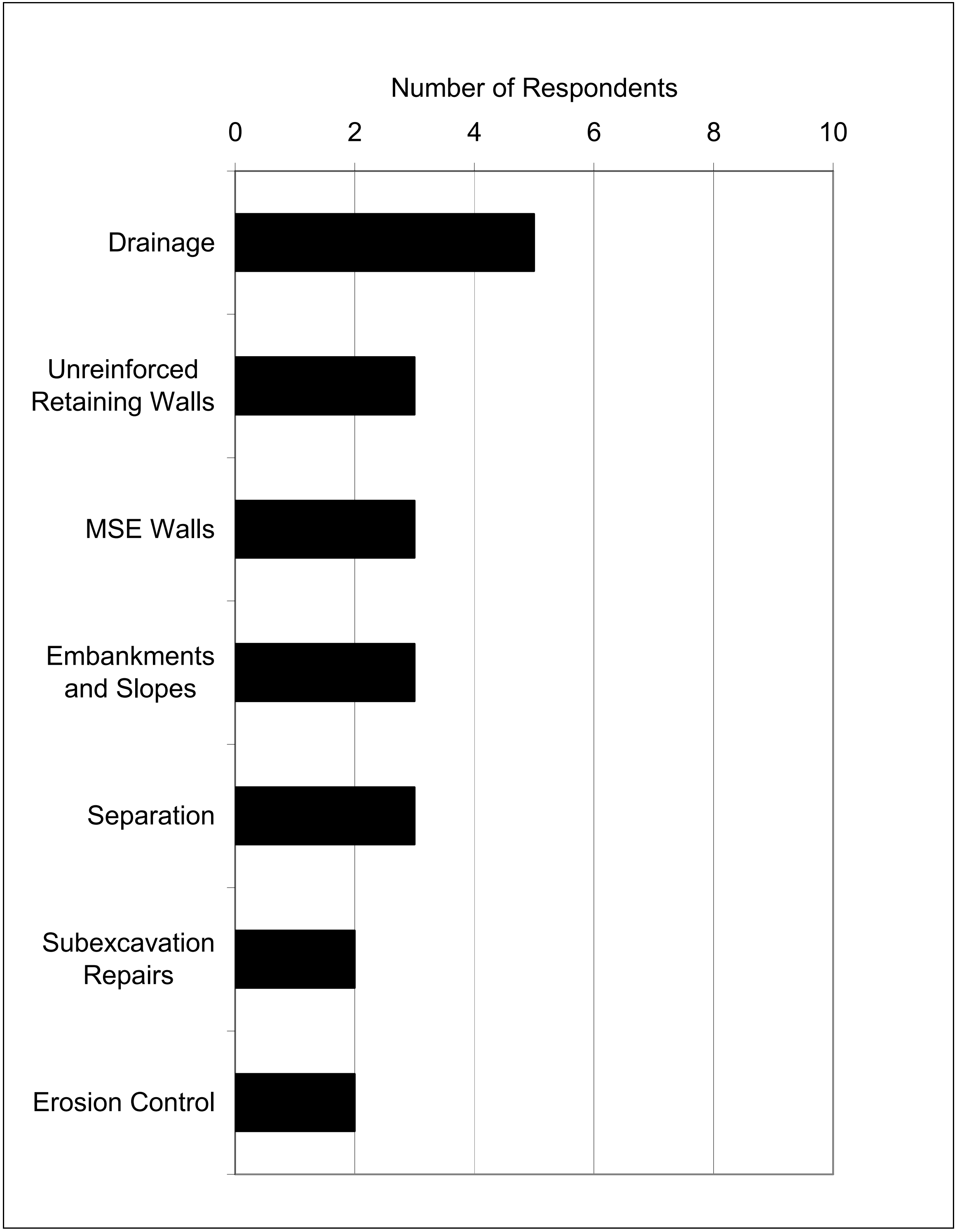

Figure 3. Graph. Reported Applications that Most Commonly Use Geosynthetics.

MATERIALS

After asking what types of projects the respondents usually encountered and whether geosynthetics are used regularly, the survey turned to the types of geosynthetics used. The survey asked about the major sub-types of geotextiles and geogrids as well as geonets, geomembranes, geocomposites, and geosynthetic clay liners. Information on the process for selecting and approving geosynthetics was also requested.

Geosynthetic Types Used

When asked if there were specifications or guidelines for selecting type of geosynthetics, nine of 11 survey respondents said yes. One said no, and one did not answer. When asked to list such guidelines, five respondents noted FP-03, four listed publications by FHWA or the National Highway Institute, and three did not answer. Two others listed special contract requirements (SCRs). Other publications listed only by one respondent were reference books by Koerner, Holtz, Christopher or Berg; manufacturer specific literature; the AASHTO manual; and details in project drawings.

The respondents were also asked to list all types of geosynthetics used by their agency. The responses to this question are shown in Figure 4.

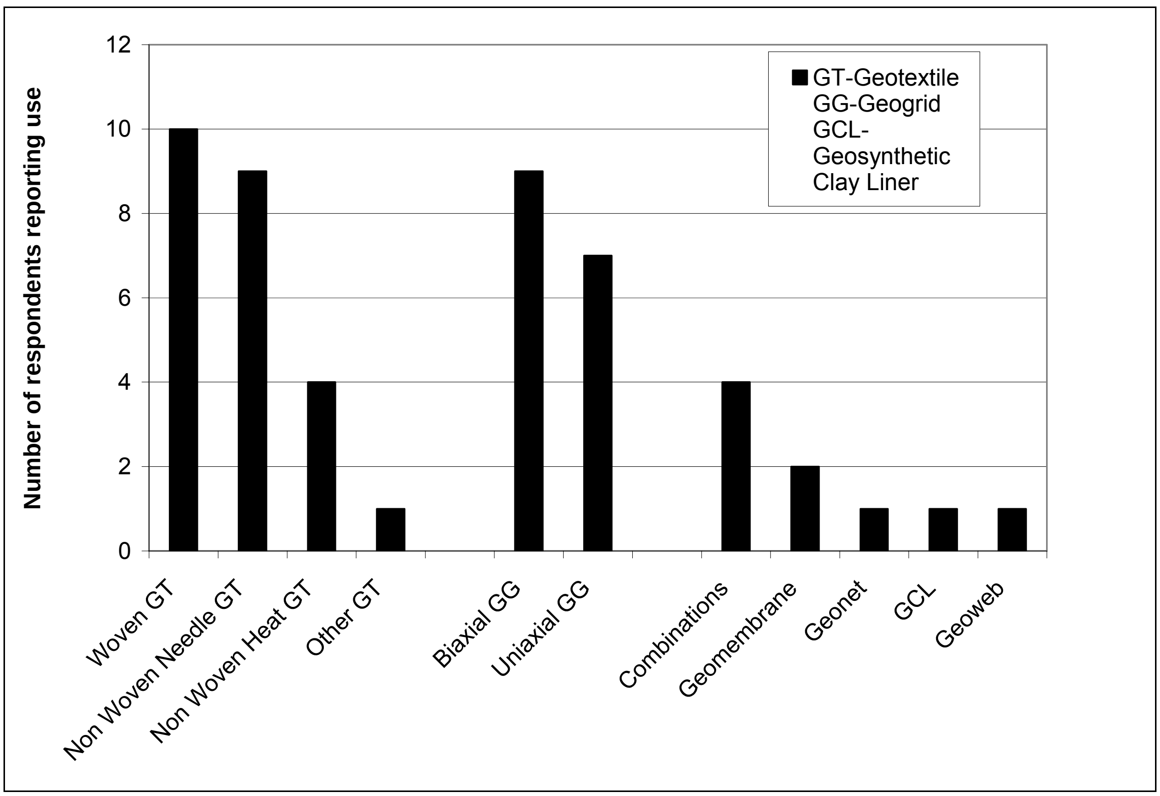

Figure 4. Graph. Types of Geosynthetics Used.

Geotextiles and geogrids are reportedly used by a majority of the respondents. Geogrid usage is a little surprising from a specifications standpoint, if not from the standpoint of available design guidelines, since these values are only covered by SCRs, and are not explicitly covered in FP-03. The "combinations" shown in Figure 4 are typically drainage geocomposites.

The majority of respondents (nine of 11) also noted that their agency does not have a pre-approved product list. A comment by one respondent noted that proprietary items are not specified unless a particular case justifies it, as is common for public agencies. One respondent thought that their agency did have such a list, however. The other respondent gave no answer.

Geosynthetic Approval and Selection

Figure 5 illustrates responses related to the product approval process. When asked how a product is approved, the majority (seven of 11) of respondents said certification letters by the manufacturer. Three respondents said research on products or methods eventually led to product approval. Interestingly, demonstration projects by the FHWA or a product's manufacturer were not cited as reasons for accepting a particular product. Likely, these types of projects are more instrumental in calibrating and developing design methodologies than directly affecting day-to-day design and construction practice.

When asked what information the respondents desire for selecting a particular geosynthetic, four indicated the need to be sure a particular geosynthetic was applicable to the required function. Two said more information on the geosynthetic's properties and cost. Three had no comment. One comment in particular captures one of the problems of using geosynthetics in practice:

> [I don't want to have] "…to provide a sales pitch to the project manager and construction people."

Thus, there appears to be either real or perceived resistance by construction personnel when it comes to using geosynthetics, which could be changed by additional education and training.

RESPONDENT EXPERIENCES IN PRACTICE

When asked if the available products and methods had yielded satisfactory results, six of 11 respondents gave their opinions. Some respondents noted good success with geosynthetics in deep patch, wall, separation and subgrade stabilization applications. Another reported construction cost and design savings. One respondent was more circumspect, saying:

"Assumed that in most cases geosynthetics are performing as required. Drainage problems, to my knowledge, have not been investigated sufficiently to determine if a geosynthetic application failed."

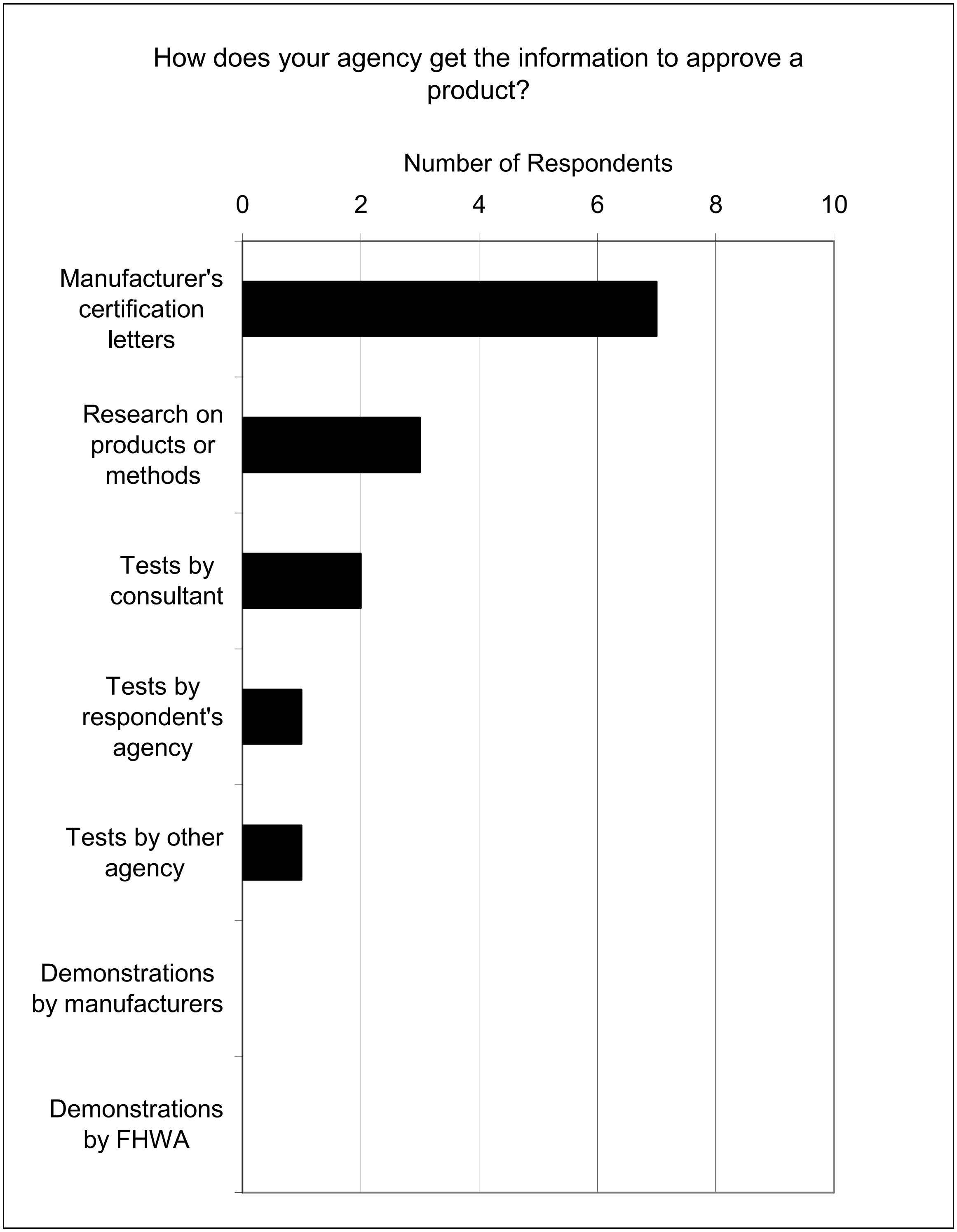

Figure 5. Graph. Information Sources for Product Approval.

When asked about unsuccessful experiences with geosynthetics, four respondents noted no problem, three had no comment and one had not had his geosynthetic projects constructed. One respondent reported unfavorable experiences for subgrade stabilization:

> "Using geosynthetics to bridge a poor soil has lead to poor results from my experience. The geosynthetic used did not bridge the poor soil, but instead, conformed to the poor soil and imbedded (sic) making the material useless."

Another respondent noted "limited results with paving geotextiles." However, in that case, the reasons for the problems were not known to the respondent. Another respondent described a project that began unsuccessfully because a contractor was not experienced installing a particular geosynthetic. Those problems were reportedly overcome, however.

CHALLENGES AND PERCEIVED BARRIERS

When asked what other challenges they felt their agency faced in using geosynthetics, respondents gave a variety of answers. One respondent felt having inspectors and contractors with enough experience to be comfortable using geosynthetics in the field was important. Another noted that knowing what products exist for application to a particularly difficult problem was a frustration, especially in erosion control applications. Some respondents also noted that the guidance for paved and unpaved roads is not consistent, and that the lack of understanding of geosynthetics function and lack of performance data are hindering further acceptance. Another noted that the height of the covering material for roadway applications and acceptance of project managers are also problems.

When asked to identify why geosynthetics are not used on a project, the most common response involved the lack of long term performance information. Figure 6 summarizes the other responses. A lack of design guidelines and a lack of awareness of applicability of geosynthetics to a particular situation were cited by five respondents as a hindrance. Surprisingly, not having prior experience with the materials and documentation in the standards was cited the least, with three respondents each.

In spite of these challenges, the respondents were still relatively optimistic about the future of geosynthetics. When asked if they thought geosynthetics had potential to offer substantial savings to the FLH Program, three of 11 strongly agreed, and five of 11 agreed. Three expressed neutral feelings.

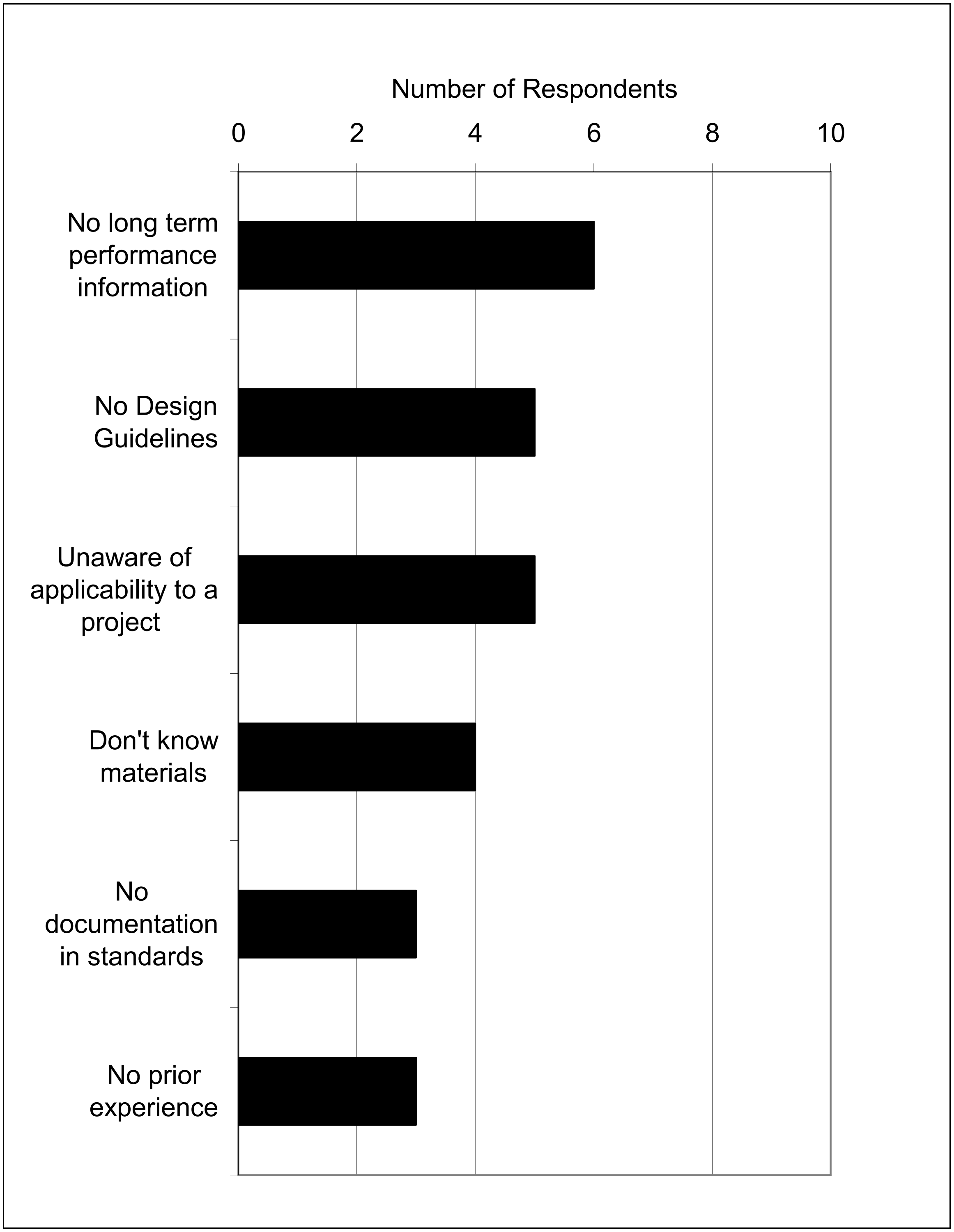

Figure 6. Graph. Reasons for Not Using Geosynthetics.

SUMMARY

In summary, it would appear the use of geosynthetics is gaining acceptance for FLHD applications and the implementation of geosynthetics in various projects is occurring. There are a number of applications where FHWA studies, publications and AASHTO guidelines have helped in this endeavor. These include MSE and reinforced earth structures, filtration applications and subgrade stabilization. Other applications seem to lag behind, due to the lack of well documented design approaches and field long term performance. These include frost heave mitigation, pavement overlays, and shallow foundation reinforcement.

In the next few chapters, each general application will be looked at in details, reviewing briefly the national guidelines identified in Chapter 2, assessing the level of maturity of an application and identifying emerging trends and recent advances in literature and practice. In addition suggestions as to where the gaps in knowledge and in practice may be for each application will be provided.