**Minimum Design Criteria (MDC) Team  
11/17/2014  
Triangle J COG, Durham**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Attendees** | | | | | |  |
| ***Team Members*** | |  | | |  | ***Others*** |  |
| Eban Bean  Bradley Bennett  Jonathan Bivens Tim Clinkscales Tracy Davis Boyd Devane Hunter Freeman Mike Gallant Joe Hinton  Marc Houle Ron Horvath Bill Hunt  Linda Lewis |  | | Brian Lipscomb Annette Lucas  Mike MacIntyre Todd Miller  Cameron Moore Tom Murray Robert Patterson Derek Pielech Peter Raabe Larry Ragland  JD Solomon Virginia Spillman Toby Vinson Rob Weintraub |  | | Julie Ventaloro, NC DEMLR  Ben Brown, City of Raleigh |

**Level Spreaders/Vegetated Filter Strips**

Annette – Is it okay just to call these “filter strips” instead of LS-VFS?  
Bill H – Level spreader is a pretty important part.  
Robert – With buffers, just putting level spreader in; buffer is the filter strip.  
Group later agreed to keep title as it was, mentioning both level spreaders and filter strips.  
  
**Item 1**  
Annette – Anything on Item 1, Level Spreader Required?  
Bill H – Edge of parking lot could function as level spreader in some cases.  
Annette – Should we say level spreader or other permanent device?  
Larry – Do we even have to use the term “level spreader”?  
Boyd - When I see the term “level spreader,” I think of concrete level spreader device, but I’ll allow other things that promote diffuse flow.  
JD – Refresh our memory about “diffuse flow” terminology. If we have a definition of that term, let’s use it.   
Bill H – Technically accurate term is shallow concentrated flow.  
Annette – TRW group came up with this definition: Uniform shallow flow that is conveyed to a vegetated filter strip. . . .  
JD – Did we put that definition in a rule?  
Annette – Not yet.   
Bill H – Prior to entering the filter strip, you must have diffuse flow.  
Larry – So it’s not level spreader required, it’s diffuse flow required.   
Annette – Prior to entering the filter strip, diffuse flow shall be established.  
Linda – Is “established” the right word? How about “provided”?  
Bill H – You could also put “immediately” instead of “prior.”  
Annette – How about: Immediately prior to entering the filter strip, diffuse flow is required. Diffuse flow is uniform shallow flow that is conveyed to a vegetated filter strip, another ground surface or stormwater practice. The purpose of diffuse flow is to remove pollutants via infiltration and settling as well as to reduce erosion prior to stormwater reaching surface waters.  
Group agreed.  
Group also later agreed to move this to Item 2.  
  
**Item 2 Forebay**  
Bill H – I think we just need to require pretreatment.  
JD – Can we still use the term “forebay” and include other forms of pretreatment as an option?  
Bill H – Forebay will likely be the most used form of pretreatment because of energy dissipation.  
Annette – How about: A forebay or other form of pretreatment shall be provided.  
Brian L – If we have a parking flow and we have sheet flow off of it, do we have to put some sort of rock edge in between pavement and grass?  
Bill H – Purpose of pretreatment there would be to isolate trash off the lot. Pretreatment is for collection of gross solids for maintenance reasons and for energy dissipation. In Brian’s case, if parking lot is releasing sheet flow into a filter strip, it’s achieving energy dissipation goal, then it’s up to them to collect trash. They can probably collect trash in the footprint of the filter strip.  
Robert – Should we change it to filter strip receiving concentrated flow?  
Brian L – That’s what I was getting at.  
Linda – Orifice discharge could be considered concentrated flow, in theory.  
Hunter – If we rename this “pretreatment” and say pretreatment is required, include in that list an upstream BMP as an option. I like the consistency of what you had read earlier, where forebay was one option.  
Rob W – Is plunge pool a BMP?  
Hunter – It would be a forebay/preatreatment device. For filter strips, a forebay is considered pretreatment -- that’s what I’m hearing.  
Rob W – Do we need to define pretreatment because pretreatment is defined differently for other devices?  
Linda – Filter strips are listed as pretreatment devices in other BMPs, so do you want to have a filter strip as pretreatment for a filter strip?  
Ben Brown – Don’t we contradict ourselves in Items 1 and 2?  
Todd- I think you have to deal with word “concentrated” after require diffuse flow in Item 1.  
JD – We want to keep filter strip from getting fouled up. Can you switch 1 and 2?  
Hunter- I like that. I agree with Todd. Does first sentence of Item 1 even need to be there? Something needs to be upstream of filter strip; needs to be diffuse flow immediately upstream.  
Annette – Could just a blind swale by itself be pretreatment?  
JD – That’s what it says.  
Bill H – It absolutely can be sometimes.  
Rob W – Can we say pretreatment for energy dissipation and gross solids shall be provided?  
JD – Yes, that’s what we’re trying to get to.  
Annette – Forebay is renamed Pretreatment and moves to Item 1. How about: Pretreatment for energy dissipation and gross solids shall be provided. Rec in chapter text: Pretreatment may include treatment in another SCM or a sump in a catch basin. The forebay may be omitted if the blind swale is lined with rip rap.  
Group agreed.

**Item 3 Design Storm and Flow Bypass**  
Todd – Does that comply with design storms and some other regs?  
Bill H – We did analysis. If you treat flows based on certain rainfall intensities, how much water will be exposed to treatment in flow-based device? One inch per hour is aggressive number; whereas if you’re capturing from 1.5” even in coast, you subject 83-86% of all water in a year to treatment. If you use one inch per hour, you subject 96-99% of all water in a year to treatment. In reality, one inch per hour lines up with catching one inch of rain, volume wise. The one inch per hour is more aggressive standard.   
Todd – What about SA waters?  
Bill H – This is a lousy bacteria-treating practice, but it hasn’t been studied for that. Issue is it’s grass – you’ll get animals coming in and eating it.   
Todd – If this is allowed in any watershed --  
Bill H – Flip side is based on filter strip footprint, particularly at coast, could get fair amount of infiltration if have separation from SHWT. You will likely have increased concentration, but loading could be much lower. Footprint will have big impact on whether or not this is good for pathogen removal on coast.  
Annette – These are not standalone devices. They’re supporting players to other devices. Bill -- do filter strips *add* bacteria?  
Bill H – If I were to bet all money in my pocket, I would bet *concentration* would go up, but *volume* of water could be reduced 80-90% in coast.  
Todd – I’d be fine if we worked out some siting standards because they’re not in there now.  
Bill H – The 0.75 inch per hour enables a lot of swales to continue to be used with difference in mowing height. If you drop to 0.75 inch per hour, you get roughly 95% of the water being subjected to treatment, which is still a lot better than 83-86% with capturing one inch of waters here in the Piedmont. One inch per hour is 98%. Sweet spot is 0.75 as far as designing it and not sacrificing much on treatment.  
Rob W – I thought rules were written by legislature that they’re dealing with storm designs and not inches per hour.  
Bill H – Issue with filter strip and swale is that they are not volume catching – these are designed to capture flow.  
Linda – We struggled with that for years about how to translate volume to flow rate for filter strips.  
Bill H – About 3 years ago, had a team calculate all of it. I’ll give you exact numbers. At one inch per hour: 98+ in Raleigh; (?) Greensboro; 97+ in Charlotte; 96% in Wilmington. If drop to 0.75 inch --  
Peter – My feeling is that if 0.75 makes it easier to do this without losing much treatment, that seems like good encouragement to use this practice.  
Bill H – It doesn’t make as big a difference with this as it does with swales. Whatever we use, we need to be consistent.  
Annette – What it does for level spreaders, it gives you a 25% discount. Say you have 4 cfs for flow going to filter strip. You’ll actually only have 3 cfs, which allows you to reduce length of level spreader. Also allows level spreaders to be designed for larger drainage areas. How many want to keep it as one inch per hour for design flow rate?   
A few people raised hands.  
Annette -- How many want to drop it to 0.75?  
Bill H – We also looked at 0.5 inch an hour: it’s 92, 93, 95, 86% (Wilmington). Once you drop to half inch an hour – I’ve said 0.75 inches an hour because I don’t like 86% in Wilmington. You could go lower.  
Boyd – We need to encourage anything we can to achieve infiltration and discourage awful ponds. I say drop it down to 0.75 or less.  
Rob W – Could we start with 0.5? If 0.5 gives us in Wilmington what we presently have with the 1.5 inch storm, and the rest of the state gets better--  
Peter – I think give enough regulatory relief dropping to 0.75.   
Rob W – I’ve seen having to walk away from level spreaders and use pond because you can’t physically fit them because of upper limit of size.   
Bill H – I don’t disagree with that. Another way to look at it. When you put in wet pond, you know you’re going to get all the water you designed it for. With these systems, you see diversion boxes get clogged, and you’ll have more bypass than you expect to have. That was part of reason why I felt – I appreciate what Rob is saying – but at same time, I know diversion boxes are not maintained as much as needed and you do get flows to bypass that are not intended to bypass.  
Rob W – When you go through O&M guides, does anything address diversion box?  
Annette – Yes.  
Bill H – Problem is it’s out of sight, out of mind. With 0.75, you’re still getting a break from the 1, but we also have this factor of safety built in.  
JD – There’s more variability around filter strip than there is around a wet pond.   
Annette: Put it to a vote:  
0.5 – 4 people  
0.75 – 10  
1.0 – 2  
Annette – 0.75 wins. Now Item 3 reads: Filter strips that receive flow directly from the drainage area shall be designed based on the 0.75 inch/hour storm flow rate, with a flow bypass system for larger storm events. A flow bypass system is not needed if the level spreader is sized to handle the 10-year storm event with a level spreader that is 100 feet or less in length.  
Hunter – When you have flow from a wet pond, nothing in this describes how to size a level spreader.  
Annette – I think that might be covered in Item 6.  
Robert – Item 3 should refer to length also.  
Hunter – But we say there are options other than level spreader. Confusing.  
Robert – All of the design requirements are for level spreader lip.  
Hunter – Just looking for consistency. Maybe package these cleaner than they currently are.  
Annette – Item 6 says length . . .shall be determined based on the flow rate. . . .   
Peter – Didn’t we just eliminate requirement of level spreader? So then talking about a required length of level spreader seems disconnected from beginning of conversation.  
Hunter – Do all of these become recommendations on if you choose to use a level spreader?  
Peter – You just have to have diffuse flow. But if you’re using level spreader, here are the minimum requirements.  
Annette – But if designer doesn’t want to use level spreader, and alternative device looks wacky, how do you deal with that as a regulator?  
Hunter – I understand not requiring level spreader for parking lot or sheet flow situation.  
Robert – I think if you have concentrated flow, you have to have a level spreader.  
Annette – We could say level spreader is the rule, but for parking lot, wouldn’t have any problem approving that as diffuse flow. Mostly what we see level spreaders are for converting concentrated flow to diffuse flow.  
JD – Concrete level lip level spreaders – there is a false belief that they’re the answer. In practice, they channelize; they’re maintenance headaches. I don’t think we need to go that way.  
Annette – What do you propose we do instead?  
JD – Leave it up to engineers to design the system right. Level spreaders don’t need to be the default.  
Boyd – I agree. Just looked at one a few miles from here. They will have to cut giant oak trees to put in level spreader. I said put a plunge pool there, and I’m happy.  
Hunter – We need to have design requirements if you do want to use level spreader.   
Annette – Buffer rules say diffuse flow, but they don’t specify level spreader.  
JD – Same argument on forebay. I could say forebay is my preference, but we just took that out.  
Bill H – One of the things that has biased the discussion against level spreaders is that we’ve tried to use them in bad places. It’s a destructive practice when you use it upslope of a wooded buffer and get worse water quality. I think we need to remember that these systems should be located upland away from riparian buffer. Then that practice looks different and you can pull off a level spreader. But in a floodplain, in riparian buffer, you’re not going to win.  
Robert – I don’t know that I’ve ever seen anyone propose a level spreader not directly next to a buffer.  
Hunter – We’ve pulled them back from the buffer.  
Robert – Majority of time people stick level spreader right there at riparian buffer. It ruins the buffer.  
Annette – Let’s not think about this practice as a way to achieve diffuse flow, but to remove pollutants. How would we design it? Also think about disconnected practice section.  
Boyd – When we change MDCs, will we change buffer rules for Neuse and Tar at same time? Purpose of diffuse flow is to meet nutrient reduction requirements. But we’ve been saying if you meet nutrient requirements upstream, you don’t need diffuse flow.  
Annette – DEMLR doesn’t have control over buffer rules anymore. TRW talked about diffuse flow and options for achieving it. Buffer program can decide what they do with their rules.  
Bradley – Two things going on at same time. All of EMC rules are going through rule review process, so they’ll both be going through. They have overlap, and that’s a consideration.  
Annette – I’d like to propose we consider LS-FS as a practice and divorce it from diffuse flow. What makes it the most effective practice? As a regulator, I’m more comfortable telling people, we have research, the best way to design it and allowing flexibility rather than completely allowing flexibility and letting university research be just recommendations.  
Todd – We need to propose standards that meet water quality standards. Is treatment with these sufficient to meet water quality standards?  
Bill H – From TSS removal standpoint, this is not going to get to the same TSS removal as a wet pond will. They don’t credit it such either. You can build a level spreader filter strip through what we’ll arrive at, and that system won’t take sediment and nitrogen out as well as wetland, wet pond, bioretention cell. But state hasn’t claimed this will work as well either. I think that’s the key. For most pollutants, this is a viable practice that’s part of the puzzle.  
Todd – I see most of these used as part of a treatment train.  
Annette – I feel more comfortable keeping level spreaders and filter strips together, but group said they wanted to separate them.  
JD – So you would say you can’t use a filter strip without a level spreader?  
Annette – Yes, in most cases, but there could be some exceptions. So is group comfortable thinking of this as a practice and not as a mean for achieving diffuse flow for buffer rules?  
JD – Sounds good for regulator, but not sure for site engineer. Sounds like could create confusion.  
Bill H – Plunge pool in a floodplain – are we going to try to put in a level spreader behind that, or would it be its own thing? Idea of putting a LS-FS in floodplain, that’s overkill, and it could be destructive environmentally.  
Annette – Boyd is reviewing plans for compliance with buffer regs. We can do some education as agency that can use plunge pool, swale with wetland vegetation, etc to meet diffuse flow requirement. And if you use LS-FS, it should be upland, etc. We can have a table in the chapter that talks about all LS-FS are for pollutant removal, and they’re no longer an option for diffuse flow? We’d be saying if the flow isn’t diffuse, you have to provide some sort of treatment, then LS-FS on grass, not right next to buffer, is one way to get pollutant removal. We’d only have engineered filter strips with flow from drainage area directly or from a BMP.  
Linda – What about part of rule that says you can use buffer as filter strip?   
Annette – Are you talking about the stormwater rule?  
Bradley – It’s written that you don’t have to have buffer prior to 50-foot riparian buffer.  
Annette – So in stormwater setback, you can disturb it and create engineered filter strip. I don’t think that would be in conflict.  
Linda – Don’t want to word what you’re doing for buffer rules to exclude ability to use buffer as filter strip under state stormwater rule.  
Robert – Confused. If have swale discharging to buffer, what happens?  
Annette – You have to provide some sort of treatment, such as LS-FS, as an example.  
Rob W – Buffer rules were set up so buffers have a function. Now we’re saying we’re not giving that credit for anything. Will be a backlash. People will say why don’t we just get rid of buffer rules.  
Annette – What’s point of people spending money on practice that’s destructive?  
JD – We would rather ban level spreader in that situation than require level spreaders everywhere.   
Tim – To say you can’t use any of the property within the buffer means you have to move the buffer back. If you can’t put level spreader at buffer line, you’re saying you can’t use property as you want.  
Peter – What are we trying to solve right now? Are we trying to define diffuse flow; how to site level spreader; where to put filter strip; how connected should filter strip be to level spreader?   
Annette – I would suggest we think of level spreader filter strip as a pollutant removal device and come up with MDCs based on that. Other issues with diffuse flow can’t be solved here today by this group.   
Brian L – In DOT toolbox, we kept them separate. Filter strip is based on velocity and slope, other than length. Then we have level spreader chapter on how long to make it. If choose to use level spreader with filter strip, you design your level spreader based off of this. Filter strip will be same width as level spreader.  
Larry – If have all of this treatment outside buffer, why have buffer?   
JD – I don’t want level spreader to be the default. There’s a lot involved with that. We need more flexibility.  
Larry – When you’ve treated water in device, level spreaders deal with point discharge from those devices.  
Brian L – I think we need to make MDC for the device and forget about the buffer rule part of it.   
Boyd – I agree with you; keep it separate.  
Annette – Let’s say that the level spreader- filter strip combo is a pollutant removal device and set up MDC to treat it as such. Let’s deal with diffuse flow in different discussion.  
Larry – Bothers me that the filter strip – not sure why you need a filter strip if you have a buffer.  
Linda – Because buffer is not necessarily a beautifully-graded place.  
Bill H – Buffer is doing other things besides treatment surface runoff. Nitrogen removal in root zone. Buffer is doing good. When we release stormwater upslope, doesn’t stay diffuse for long and ruins buffer. Let’s say you a have grassed filter strip that’s putting water in the ground 150 feet from buffer. Will flow through root zone of buffer where nitrogen will be removed. You need the buffer. I hate the idea of discharging bunch of runoff immediately at the edge of it because it will ruin the buffer.  
Larry – That’s the reason for diffuse flow.  
Annette – That’s why we’re trying to divorce them.   
Bill H – For the filter strip to work, you also need diffuse flow.   
JD – So are we going to format of DOT?  
Brian L – Because we claim shoulders to be filter strips, we restrict how steep they can be, and we put length of 30 feet or 50 feet depending on SA waters or not. That’s the limit of that. There’s a velocity into it that dictates how wide it is. Level spreader is 10 foot for every cfs to dictate that length. Then specifics on how deep trough needs to be, things like that. Level spreader provides diffuse flow. You can use it with filter strip, but if you’re designing just to meet buffer rule, you just have level spreader.  
Annette – So purpose of DOT’s level spreader chapter is to meet diffuse flow. I think we should look at LS-FS as device to remove pollutants and not for diffuse flow for buffer rules.  
Group agreed.  
Annette – Item 2 (now Item 1) still applies. Item 1 (now Item 2): keep wording diffuse flow. For Item 3, we have: Filter strips that receive flow directly from the drainage area shall be designed based on the 0.75 inch/hour storm flow rate, with a flow bypass system for larger storm events. A flow bypass system is not needed if the level spreader is sized to handle the 10-year storm event with a level spreader that is 100 feet or less in length.  
 **Item 6**  
Annette – Should we combine Items 6 and 3?  
Hunter – Yes. But do we need Item 2?   
Bill H – Depends on how much wiggle room you have for options of using something other than a level spreader. If you have wiggle room, keep Item 2.  
Hunter – Disconnected impervious, we discussed if have concentrated flow, you go to engineered filter strip chapter. This is mainly about when you have concentrated flow, getting credit for it.  
Annette – A number of people said they wanted to get rid of diffuse flow verbiage. To simplify things -- because we are thinking of this as a water quality device -- delete Item 2?  
Group agreed.  
So for Item 6, Level Spreader Length, make it Item 2. Level spreader-filter strips that receive flow directly from the drainage area shall be designed based on the 0.75 inch/hour storm flow rate, with a flow bypass system for larger storm events. A flow bypass system is not needed if the level spreader is sized to handle the 10-year storm event with a level spreader that is 100 feet or less in length. The length of a level spreader that receives flow from an SCM shall be based on the drawdown rate of the treatment volume. The level spreader shall be 10 feet per cfs of stormwater flow. The minimum length of a level spreader shall be 10 feet and the maximum length shall be 100 feet.  
Rob W – What is the magic of the 100-foot length requirement?  
Annette – The longer it is, the harder it is to get 100% level.  
Rob W – You can get concrete pretty level. You can have pretty long runways. Contractors use pre-formed devices a lot of the time. I think we should get rid of max length.  
Linda – if they can engineer it, why not?  
Larry – You can split it and have several 100-foot spreads. Can you find an area on your site where more than 100-foot level can apply? That topo changes as you go upstream, so if you get much more than 100-feet, you have to cut much more to get that level circumstance. Breaks make sense. I don’t think 100 feet mean anything if the engineers can design it. I think that’s an arbitrary number.  
Brian L – We have that length restriction on there, but we’re not developing sites; we’re doing stream crossings.  
Annette – Do you think it would be possible that the concern was based on perceived logistical issues with pouring something longer than 100 feet that would be flat?  
Robert – I’ve never seen a *10*-foot level spreader that was level.  
Rob W – I disagree. I’ve seen preformed ones that are level. A lot of contractors have figured it out. We’re restricting things unnecessarily. Today people use lasers.  
Hunter – Mission of MDC -- does 100 foot limitation do anything for water quality or function in perpetuity? I’m hearing that it doesn’t.  
Annette – Spirit of MDC is we spec for water quality, and design professionals make it work in the field. I’m okay with taking out 100-foot max.  
Todd – What’s tolerance for it not being built correctly?  
Annette – We have one that’s 2%, but I’m open to discussion on that.  
Tim – Where does 10 foot come from?  
Hunter – Propose moving section in pond discharge to before flow bypass.  
JD – Will there be a scenario where you’d have to build it 150-feet?  
Annette – It is what it is. You do the calcs, you have this flow rate, corresponds to level spreader of a length. Then designer either doesn’t use it or splits it.  
Hunter – Do we need to specify level spreaders can be split?  
Tim – That’s the doofus rule. If they can’t figure that out --  
Annette – Here’s what we have now:  
Level spreader length – The level spreader shall be 10 feet in length per cfs of stormwater flow that is directed to it. Level spreader-filter strips that receive flow directly from the drainage area shall be designed based on the 0.75 inch/hour storm flow rate, with a flow bypass system for larger storm events. The length of a level spreader that receives flow from an SCM shall be based on the drawdown rate of the treatment volume. A flow bypass system is not needed if the level spreader is sized to handle the 10-year storm event . (Rec in chapter – it is okay to split flow.)  
Group agreed.

**Item 4 Blind Swale**  
Bill H – If you have a level spreader, you need to have a blind swale. There has to be something concave that holds water before it goes after level spreader. No matter how shallow, that could be your blind swale. Swale need not be grassed.  
Annette -- Add this into Item 1 Pretreatment?  
Bill H – Don’t want water to jump the level spreader. When a level spreader is overtopped, it would be uniform in nature.  
Annette – Maybe item 3 should just be this: Immediately upslope of the level spreader, there shall be a blind swale or other method of ponding water. The blind swale shall be designed to provide for uniform overtopping of the level spreader. (Rec: Water shall enter the blind swale in a nonerosive manner. If the blind swale is lined with grass. . . .)  
Group agreed.

**Item 5 Level spreader Specifications (now Item 4)**  
Bill H – One percent is too steep. What can you hit?  
Linda – Half a percent --  
Joe H – A quarter inch per 10 feet. If it’s one percent per some linear footage --  
Peter – How close can folks get?  
Rob W – Jonathan needs to answer that. We cut aluminum pipe in half, dug trough, buried it, it was a quarter of a percent. Then you get preformed pipe, you can go half a percent. I don’t know if that’s what we want to recommend. To me, it’s between half a percent and one percent.  
Robert – Should shoot for zero.  
Ron H – Shooting for zero, but can’t get there practically. We’ve been accepting on level spreader if it’s less than 4 tenths of a percent on a certain distance. If it’s over a 10-20 foot area, there’s a little deviation. Time is your enemy because of frost heave, shrink, you get minute movements. There’s got to be some tolerance over 10-25 foot length. At 100, you’ll be quarter or half foot out if you’re not careful.  
Bill H – Anywhere along length of level spreader, could you be plus/minus ?  
Ron H – Is quarter inch acceptable? Half inch?  
Larry – Elevations are measured in hundreds of feet. 200 feet is acceptable.  
Tim – Can’t even survey at that --   
Rob W – If it went down and came back up. More critical that endpoint is within tolerance. Other thing is when we look at perfection of device, nicest level spreader I ever built was used by deer as a path. So device was beautiful, but blind swale and filter strip had really significant low spots that were created by deer. You can fix it, but deer will outlast O&M guidelines.  
JD – Can we look at it as performance spec instead?   
Rob W – So no less than 90 or 95 of level spreader works during normal rainfall?  
JD – Leave it nebulous?  
Bill H – Shall have uniform overtopping.  
Ron H – Problem I see is who’s writing certification that it’s level? Another engineer at State, city says don’t agree. They have no common sense. That’ what I’m getting stuck with.  
Bill H – When it’s out of tolerance, we put a metal sheet on it and made the metal sheet level, fixed it to the concrete. We were on extraordinarily tight tolerances for research purposes.  
JD – I would question variability of that too.  
Rob W – Criteria for how level it is has to carry it through maintenance also. Can we say that there’s no obvious erosive spots on downside.  
Bill H – Filter strip works as long as water sees it during design storm. Lower flow rates it’s okay for filter strip not to see all of water. But at 0.75 inches per hour, entire length of filter strip should see water.  
Slope doesn’t matter if it’s quarter inch on 30 feet or 70 feet . It’s at any elevation, you’re allowed to be off a quarter inch. What’s your tolerance at any point?  
Linda – The design elevation –  
Ron H – I agree with quarter inch. You can achieve it. How many points do we shoot along this? Every foot? It becomes a practicality issue. This is what we deal with.  
Larry – Issue at sites -- is it going to be worse tearing it out and fixing it to some standard or keeping it as built? Sometimes they have to carry out other stuff that was fine just to fix one thing that’s wrong. I’d hate to make them tear it out because they’re three hundredths of a foot off at one point.  
Tim – What is floor tolerance, a quarter inch? We’re not building floors.  
Bill H – It’s a fraction of an inch – might be a quarter of an inch --  
Tim – Then ours needs to be more than that.   
Ron H – Level spreaders do not function properly, period. They’re going to make their own channels on the other side.  
Todd – If we hear all these issues with level spreaders, why do we require them at all?  
Annette – Goes back to buffer rules, but then research shows that level spreaders with filter strips can work great.  
Bill H – Tolerance is a key number. We want to get it right. Should be as low as possible and practical.  
Rob W – What is permanently stable material? Steel? Wood?  
Annette – We may have to define that a little better for the RRC.  
Annette – How about: The lip of the level spreader shall be at a uniform elevation with a construction tolerance of plus or minus ¼” at any point along its length. The level spreader shall be constructed of concrete or other permanently stable material.  
Group agreed to keep tolerance as ¼” for now, but can come back with higher tolerance if that is found to be unreasonable.

**Item 7 (now Item 6) Level Spreader Shape**Bill H – Can say level spreader shall not concentrate flow.  
Hunter – There is a radius on the concave --   
Annette – Bill, I get what you’re saying, but that seems vague. People might not realize that you’re talking about plan view.  
Bill H – The shape of the level spreader in plan view shall not concentrate flow.  
Rob W – Issue is we’re building a level spreader with a filter strip, so does shape matter that much?  
Bill H – Shape of level spreader in plan view shall provide flow across the entire footprint of the filter strip. Entire footprint of filter strip should see water during design storm. If you make it concave --  
Annette – Worried about overloading certain part of filter strip.  
Linda – What’s to prevent them from making it donut shape?  
Rob W – On a concave one, the water shoots out as it comes across level spreader. But eventually can cross back because water’s traveling downhill. So why does it matter as long as it reasonably functions?   
Eban – Has anyone seen a concave shape?  
Hunter – Art museum. If you took that basic layout and replaced fancy stuff with grass, would that be detrimental to water quality?  
Robert – if it’s a really concave discharge point, don’t even need a level spreader.  
Annette – it’s a water quality device, remember.  
Robert – if that’s the case, then what Bill had – it doesn’t matter if it reconcentrates after it leaves the filter strip.  
JD – Let’s take the item out all together.  
Bill H – As long as on the end of the filter strip, as long as inner width, discharge point, is certain width, and have diffuse flow, you’re fine. Length that really matters is discharge length at end of filter strip.  
Eban – If level spreader is longer than that, and that’s what governs 1 cfs per ten feet, you’re getting more diffuse flow as it enters, and it won’t concentrate any more at bottom of filter strip.   
Annette – Special design standard for concave level spreaders.  
Bill H – How many people are actually doing this? Aren’t they all rectangles?  
Linda – Because we tell them they can’t have concave.  
Brian L – We’ve done convex in Randleman.  
Annette – Can say level spreader should be this length if it’s concave.  
Todd – So where do we say that in the standards?  
Annette – How about this: Special provisions for concave level spreaders. If a level spreader is concave, then the required length of the filter strip shall be measured at the downslope side of the filter strip.  
Boyd – Could just say other designs may be acceptable if they provide equal treatment to the rectangular design? Wouldn’t want to encourage concave or convex either way.  
Linda – Length of the narrowest point of the level spreader --  
Brian L – It’s the width of the filter strip, not the length.  
Annette – We at DENR had called this the width and this the length. We adopted this because level spreaders were associated with buffers which are based on width. I’m open to changing it.  
Joe H – Does this make it more complicated for minimum design, which we should be making simple?  
Annette – We do seem to be making something more complicated that doesn’t come up that often.  
How about this: The level spreader shall be straight or convex.  
Group agreed.  
  
**Item 8 Stone Verge (now Item 7)**  
Annette – 3 foot stone of 57 stone is currently spec’d. Keep, change, or eliminate?  
Linda – What is purpose?  
Annette – Prevent erosion.  
Linda – So it is a water quality reason, so probably should keep it.  
Robert – 3 feet seems too wide. Maybe 8-12 inches; just need something there.  
Boyd – Is that the width? What about the depth?  
Joe H – Minimum of four inches?  
Linda – If they use concrete level spreader, what would standard curb level be?  
Ron H- Stone you don’t want above lip. Are you going to have minimum exposed lip?  
Brian L – We have 4” from level spreader down to stone.  
Larry – That way stone is acting as splash area.  
Annette – Do you have spec for depth of stone, Brian?  
Brian L – No, but we also don’t call for stone specifically.  
Larry – Problem we have with stone is that stone-grass edge gets diffused and you get pockets of water and erosion at that edge. Better solution to just to IncaMat(sp?), soil reinforcement.  
Larry – What do they call turf reinforcement used on dam emergency spillways? That would be distinction between jute mesh and – maybe use high performance turf mat which is in the State’s erosion control manual.  
Annette – How about: Transition Zone. Immediately downslope of the level spreader, there shall be a 4 inch drop followed by a minimum 12 inch wide area that is protected against erosion via aggregate or high performance turf reinforcement matting.  
Group agreed  
  
**Item 9 (now Item 8) Minimum Width of the Filter Strip.**Annette – How about: The minimum width of the filter strip shall be 30 feet.  
Group agreed.  
Boyd – Should we put minimum width is measured perpendicular from level spreader lip, or something like that? In some of our filter strip rules, you read width the other way.  
Eban – Seems like perpendicular to level spreader lip would be length, not width.  
Annette – How about: The minimum width measured perpendicular to the level spreader lip of the filter strip shall be 30 feet.   
Group agreed.  
Annette - We said 30 feet because research has shown little benefit from additional 20 feet of width (to match buffer rules).

**Item 10 (now Item 9) No draws or channels in the filter strip.**Tabled until after deal with Item 11/10 Engineered filter strip.

Item 11 (now Item 10) Engineered Filter Strip  
Annette – All filter strips done for pollutant removal will be engineered, so can remove engineered part.  
Joe H – What do you mean by non-clayey soils? In some biocells, sod from sandhills vs clay loam, clay loam does much better as far as establishing.  
Annette – Idea is there wouldn’t be impermeable layer of clay mixed in with grass roots.  
Joe H – Permeability is not a problem in clay loam sod. Could have problem with straight clay. Grass won’t grow very well in clay to begin with, so won’t make sod with it.  
Larry – Does it have to be grass sod? Is that only vegetation we can use?  
Joe H – I’m just talking about grass in clay loam soils does better in our areas. Some of it is species. Fescue does better in some areas. Only way you can get non-clayey sod is sandhills or down coastal.  
Larry – Most cool season grasses will eventually clump, even if installed as sod.  
Linda – Clumping is more like weeping love grass that are already clumpy when you plant them.  
Joe H – What we suggest is that’s when you reseed and that’s part of the maintenance.  
Larry – If your filter strip is on north side of woods edge, there will never be enough sun to grow any grass.  
Joe H – There’s some Kentucky bluegrass that will do okay.  
Larry – Anything more than 50% shade, grass just won’t work.   
Larry – Would like to allow other vegetation, like honeysuckle, other vines. Root structure holds things.  
Brian L – Part of reason why filter strip is certain depth is surface contact. If you have taller stuff with trunks --   
Larry – Would like Dr. Hunt’s group to do more research on different vegetation, especially in areas with 50% shade or more.  
Annette – Could you live with it if we require grass sod for now?  
Larry – I require grass sod, but I come back later in 3 years, and it’s dead in areas without sunlight.  
Peter – It might be dealt with as an alternative, just might not be fast track. Maybe have a recommendation as far as siting and sunlight. Because if the sod is dying, then it’s just dirt, not doing anything.  
Brian L – I’ve been told that there are no “native” turf grasses to North Carolina.  
Peter - What if we took out the word “sod”? Would that open it up?  
Joe H – Purpose of using sod is for quick establishment.  
Annette – How about this: Filter strips shall be graded with a uniform transverse slope of eight percent or less. Within the first 12 inches of the soil surface in the filter strip and any adjacent cut slopes, the pH, compaction, and other attributes of the soil shall be adjusted if necessary to promote plant establishment and growth. The filter strip and side slopes shall be planted with non-clumping, deep-rooted grass sod.  
  
**Item 12 (now Item 11) Natural Filter Strip**Annette – Propose that we delete this item.  
Group agreed.

**Item 13 (now Item 12) Siting**  
Todd – We shouldn’t be using these for SA waters because of bacteria.  
Annette – Bill also said they could be providing a lot of infiltration though.  
Linda – We’ve been dealing with “effective” infiltration. That’s what most of the LS-VFS are used for. If you want them to be more infiltration areas, then we need to figure out do we want to bring back the water separation? This isn’t a standalone device for SA waters.  
Todd – Once this is out there as MDC, will people know that it’s a part of treatment train?  
Annette – Statute, coastal rules haven’t changed. Device itself doesn’t make bacteria worse. It’s the animals it can attract.  
Derek – We have that problem with wet ponds too. I think you’re talking about a rule issue; this is a design standard.  
Annette – I think it’s outside of the scope of what we’re doing here.  
Peter – Since this will be adopted in a rule, will that create a conflict between the SA rules?  
Tim – Doesn’t conflict. Says you can have secondary treatment with zero separation.  
Bradley – There’s another statute that says the MDCS have to be designed to protect water quality standards.  
Todd – Why are we recommending something that will make water quality worse?  
Annette – We have research that shows these work for sediment and nutrients. Are you saying, Todd, that you want the rule or manual to disallow level spreader filter strips in SA waters?  
Derek – Does state have a standard for bacteria?   
Annette – No.  
Todd – We have a standard for receiving waters for bacteria.  
Bradley – What Todd is referring to is standards for a lot of receiving waters. The statute that tells us to protect water quality standards. That’s very broad.  
Linda – I don’t see much difference between animals using natural buffer vs this constructed device. The runoff still gets into the stream.  
Todd – Coastal stormwater rules are nondischarge rules, and we are designing a discharge system here.   
Tim – We’re already holding crazy amounts of water in a pond. This is the compromise between environmentalists and developers.  
Annette – My feeling still is that this engineering standard isn’t the place to address that SA provisions if our standards aren’t protective enough. I shy away from talking about specific drainage areas in the manual. Then you have to update the manual or the rules.  
Rob W – I thought that buffer rules allow us to put filter strips in buffer as allowable use. Now we’re saying no. I thought buffer rules would guide this.  
Annette – Let’s not put in our manual how these rules interact with each other.  
Peter – All the designs we’re putting forward will meet TSS, plus nutrients, etc?  
Annette – Yes. And right now level spreaders do not get 85% TSS.  
Peter – Anything in manual about bacteria?  
Eban – Can we resolve this by recommending level spreaders not be used for bacteria removal?  
Larry – Any recommendation will end up being enforced as a rule.  
Tim – No. We have a whole bunch of recommendations that are not going to be enforceable MDCs.  
Annette – I see what you’re saying, Eban. I think we should address this outside of this process.  
Tim – I think the legislature can fix this.  
Annette – Propose to get rid of Item 13 Siting  
Group agreed.

**Sand Filters**Annette – Took some verbiage from bioretention and took some from chapter. I don’t see a lot of sand filters, but when I do, there are a lot of questions.  
Item 1 SHWT Separation. How about: The SHWT shall be at least two feet below the bottom of the sand filter for open-bottom designs and one foot separation is required for closed-bottom designs. Exceptions to the one foot SHWT separation may be made if the sand filter does not drain the water table and it does not float.  
Group agreed.

**Item 2 Excess Volume/Flow Attenuation**  
Annette – Off line only? No votes  
On line and have flood control? Group agreed  
Hunter – I don’t think there’s a reason to have a limit.  
Mike M – I don’t think we should have more than 5 feet. Having 5 feet keeps the whole thing stable.   
Brian L – You’re going to be limited by drawdown time  
Mike M – I would recommend max 5 feet.  
Annette – That’s pretty generous. That’s 5 feet above top of sand.  
Hunter – I need more than that. As far as ponding water, if you can design a concrete vault that’s 20-feet deep -- if you’re doing it for peak attenuation, I’d have orifice there.   
Boyd – You gotta have settling time. Would you change your detention time any; could it be shortened?  
Hunter – Still going to have detention time and filtration component for that volume. If more comes into system --  
Joe H – Discharge is at fixed rate –  
Ron H – I like it, plus gives you more room for maintenance.  
Annette – So it’s not like an MDC anymore. How about: Sand filters may store peak attenuation volume above the treatment volume ponding depth.  
Group agreed.

**Item 3 Maximum Drainage Area Size**  
Mike M – In Charlotte, we’re limited to 10 and we’re studying how to increase it. If you all are getting rid of it, maybe we can get rid of it too.  
Group agreed to remove.

**Item 4 Two Chamber System**  
The sand filter shall include a sedimentation chamber and a sand chamber.  
Group agreed to keep as is.  
  
**Item 5 Maximum Ponding Depth**  
Annette – How about: The maximum ponding depth for 75% of the treatment volume shall be six feet. The ponding depth is typically measured from the top of the overflow weir that separates the sediment chamber from the sand chamber.  
Annette – Similarities from Infiltration, must completely dewater within 72 hours . . .  
Brian L – What did we do with bioretention?  
Annette – We were quiet about it. People can continue to design to be a bowl to hold whole treatment volume, or they can route storm through bioretention cell and reduce size of bowl. As I was typing this late last week, this isn’t consistent with infiltration and bioretention. Curious what you all think. Sand filters have high loading rate and more likely to clog.  
Linda – Especially if you don’t limit drainage area.  
Annette – So that could be argument to take 75% of volume and not allow to route. One approach is to keep it the way we have it. Option 2 would be infiltration way where it’s always a routed system, dewatering within 72 hrs. Or option 3 do it the bioretention way where you’re quiet about how you get to max ponding depth.  
Linda – I need to see it all written down.  
Annette – I think one issue with sand filters getting hung up in reviews – chapter doesn’t use consistent terminology. Sedimentation chamber is higher than sand chamber in one part of manual, then have closed system with very different design.  
Linda – Also makes it impossible to create supplement form for it.  
Hunter – I design sand filter to have no overflow, designed chamber just states volume it needs to hold to be equal or greater than it needs to hold, no routing. The way this is worded is a little clearer than how bioretention used to be worded. Raised questions about routed elevation or not. I’m okay with this language for sand filters. Other people may have run into issues.  
Mike M – We have tons of sand filters. We have folks route the sand filters.  
Annette – So would we word it same as bioretention – maximum ponding depth 6 feet above sand?  
Hunter – Maximum ponding depth from top of sand to overflow weir shall be 6 feet? That’s what the second sentence is saying, that’s how it’s measured.  
Annette – Can we say outlet structure in case no weir?  
Linda – You can just say outlet elevation.  
Hunter – Or to the next outlet elevation. Trying to remember how we phrased it in bioretention.  
Annette – We said maximum ponding depth of treatment volumes shall be 12 inches above planting surface.  
Annette - How about: The maximum ponding depth from the top of the sand to the outlet elevation shall be six feet.  
Group agreed.  
Hunter – Are we taking out three quarters? Or do we need new bullet here?  
Annette – I feel like you pick one or other; either you route it for whole storm, or we slap you with 75%.  
Hunter – I see what you’re saying. I see why you’re not blindly giving them three quarters.  
Linda – If they route it no minimum volume required anymore? Size of system doesn’t have to be sized to store “x” amount anymore?  
Annette – You’d have to compute that.  
Linda – What we did before -- we always tell people if they want to overdesign an infiltration system for 10-year storm, we say if you can route 10-year storm thru the system and show you don’t have to make larger, then that’s fine. But at a minimum, size of system has to be pre-post 24 hour or 1.5 inch storm, whichever is applicable. Must be demonstrated that it can handle 10-year storm.  
Annette – There are some calcs further down that are required for sizing. So you don’t like this wording in Item 5?  
Linda – That is specific to depth, not volume.  
Hunter – I’m not sure this is sufficient to ensure whole box is sized correctly? What about the area?  
  
**Item 6 Drainage Time**  
JD – What is basis for 40 hours?  
Linda – Based on specs for sand filter media and depth, must go through 3.5 feet per day.   
Rob W – So if we made it for 48 hours, could we make it smaller?  
Hunter – Also might be tied to three quarters number. Should be able to drain quicker. Sand filters not trying to get any retention. I’m okay with draining slower.  
JD – I think you should put 2 days, not any number of hours.  
Hunter – If we’re 6 feet maximum, would drain max of 2 feet per day.  
Boyd – So you’re saying our pond calculations weren’t based on detention?  
Hunter – For sand filter, designing it for filtration not detention.  
Brian L – Why does it differ from 2-5 days? Might be some research about time requirement. We should be careful not to put so much head on it that water is just gushing through it and not getting filtered.  
Annette – Should we table drainage time until we talk to Bill?  
Group agreed.

**Item 7 Sediment Chamber**  
Annette – I don’t know purpose of this.  
Group agreed to remove.

**Item 8 Sediment Chamber Sizing**Annette – The size of the sediment chamber shall be [see calculations in Manual]. . . . If you divide treatment volume by 15 feet, get surface area of sediment chamber. This is based on Camp Hazen Equation.   
Bradley – I don’t know if we have any other method to follow.  
Linda – People ask why we don’t use same as for wet ponds, 20%  
Annette – We might want bigger ratio of pretreatment to treatment becauseit’s a high loading device.  
Ron H – Aren’t most of sand filters impervious areas?  
Hunter – Usually highly impervious, under parking lot.  
Ron H – Not a lot of contaminants. Volume of sediment storage doesn’t need to be large.  
Hunter – Use sediment storage area to protect sand area. Make them 50-50 in size. I do run the calcs. They give you some weird numbers, so low that you would have to make sand filter so deep. 6-foot maximum drives what the size should be. That’s based on my experience.  
Mike M – Ours are a little different because we also have volume control. I can get more information on this. Our filters are sized a little differently.  
Hunter – Basically, the treatment volume drives size of sand filters.  
Annette – Do you look at volume in sedimentation chamber plus --  
Hunter -- Plus volume over the sand.  
Annette – You’re designing closed systems?  
Hunter – Yes. [Drew diagram on white board to show how he typically designs sand filters.]  
Linda – 50/50 is a recommendation in the manual. Seems odd because sizing requirements are so different.  
Hunter – We try to avoid sand filters because of long-term O&M.  
Annette – In Item 4, we could say it’s recommended to provide equivalent volume in each chamber.  
Group agreed.  
Group agreed to eliminate Item 8.

**Item 9 Minimum Width of Sedimentation Chamber**  
Group agreed to eliminate this item.

**Item 10 (now Item 8) Flow Distribution**  
Group agreed to keep as is.

**Item 11 (now Item 9) Sand Media Specification**  
Hunter – We’re not trying to grow anything, do we need P?  
Annette – It’s to avoid having too much phosphorus.  
Joe H – We’re talking about clean, washed masonry sand. Has anybody found any phosphorus in it?  
Brian L – I’ve had P indexes of 3.  
Joe H – That’s because person who ran it had range of 0-4.   
Derek – If it meets that ASTM standard, it qualifies.  
Joe H – You’re describing two different things. Clean washed sand is not going to have phosphorus in it. If you want to say sand media shall meet ASTM. Or you eliminate ASTM and say clean, washed.  
JD – Natural sand won’t be washed. Do you want natural sand or not?  
Linda – We have allowed it.  
Derek – Sand media shall meet ASTM C33 or natural sand --  
Annette – How about Sand media shall meet ASTM C33. If a native sand is used, then the phosphorus index (P-index) for the media shall be less than 50 if the receiving water is class B,C,SB or SC with no supplementary classification. Otherwise, the P-index shall be less than 30.  
Boyd – What about NSW supplementary classification? Say shall be 50 unless it’s NSW supplementary classification, in which case P-index less than 30.  
Annette – How about Sand media shall meet ASTM C33. If a native sand is used, then the phosphorus index (P-index) for the media shall be less than 50 if the receiving water is NSW, in which case, the P-index shall be less than 30.  
Linda – Isn’t there a phosphorus standard for the State?  
Annette – Apparently, there’s really high phosphorus levels in some soils.  
Eban – I would be surprised if you had high P-index on soil that met that standard.  
Joe H – The first part, about ASTM, yes.  
Eban – But you wouldn’t have high enough clay to meet that.  
Joe H – Soil off tobacco fields -- something is binding phosphorus there -- it’s crazy. Nobody can explain it yet. Washed sand -- it’s about 99% chance you don’t have anything.  
Peter – Is this a big burden to test?  
Joe H – No.  
JD – I don’t know why anybody wants to use sand filter anyway.  
Boyd – Need to say just use ASTM and leave it at that.  
Annette -  
Option 1: Sand media shall meet ASTM C33. – most votes  
Option 2: P-index only for NSW – two votes  
Option 3: P-index for everything (Sand media shall meet ASTM C33. If a native sand is used, then the phosphorus index (P-index) for the media shall be less than 50 if the receiving water is NSW, in which case, the P-index shall be less than 30.)– no votes  
Group agreed to Option 1.

**Item 12 (now Item 10) Media Depth**  
The filter bed shall have a minimum depth of 18 inches, with a minimum depth of sand above the underdrain pipe of 12 inches.  
Group agreed

**Item 13 (now Item 11) Sand Chamber Sizing**  
Hunter – I think we need to wait for Bill because it’s tied to drain time. Infiltration rate of size, volume that has to pass through it, easy to get sizing. Total volume stored in both, plus drain time, calculate sizing. Volume, drain time, permeability of sand are the three variables. Need to set two of these to calculate the third. Only question is is there a minimum drain time? That’s where Bill’s research will help. Sand can’t be so coarse and expect it to get solids out. There’s got to be some minimum. ASTM C33 might be fine. Once you know that, it will drive how big the sand needs to be.   
Boyd – Isn’t there a set number for ASTM C33?  
Linda – I think that’s where that number came from.  
Bradley – I think Greensboro may have had input on this chapter.  
Group agreed to table this.

**Item 14 (now Item 12) Maintenance of Media**  
Group agreed to table this.

**Item 15 (now item 13) Underdrain**  
Annette – Do we want to allow internal water storage?  
Linda – I think it would result in perpetually wet bottom. If underdrain, if storage is allowed to get on top of underdrain, and it can’t get out --  
Brian L – If it’s open bottom, it could be okay.  
Annette – Maybe we can put it in as recommendation – Internal Water Storage. Underdrain with internal water storage may be installed if in situ soil infiltration rate is . . . .  
Group agreed to make this a recommendation

**Item 16 (now Item 14) Clean-out pipes.**   
At least one clean-out pipe shall be provided on each underdrain line. Clean out pipes shall be capped.  
Group agreed.  
  
**Action Items**Annette –Send Team additional homework in 2 weeks.  
Team – Review chapters and additional homework as assigned.

**Next Meeting – December 15, 2014 – 9:30 to 3:00.**