From: Theisen, Greg [Greg.Theisen@portofportland.com]
Sent: Friday, January 25, 2013 12:16 PM
To: Engstrom, Eric (Planning); Hoy, Rachael; Brooks, Mindy (Planning); Nameny, Phil (PLN)
Cc: Lahsene, Susie; Harrison, Marla; Green, Dana; Whitlock, Ian
Subject: WHI PSC Qs 18, 20-23

Attachments: 2012-10-29_FloodplainResponse.doc

		Floodplain Functions			
18		How can the Port and City achieve net gain in ecological function while ignoring 300 acres of floodplain fill?			X
19	1/16	Has Planning and Sustainability and BES sorted out concerns that the city might face significant liability if it allows filling of the floodplain without mitigation? Relationship to FEMA lawsuit?	X		
20		Describe the technical basis for a balance cut and fill requirements?		X	
21		The loss of ecological functions associated with the Columbia River floodplain must be accounted for and some form of mitigation included in the IGA. Are there are methods short of balanced cut and fill that would help mitigate for loss of floodplain function?			X
22		Can we provide some more scientific evidence to counteract fears that the fill will increase flooding up or down stream?		X	
23		What are the potential mitigation costs for balanced cut and fill?		X	

Eric and Rachael,

Thanks again for the opportunity to provide responses to the PSC questions on WHI annexation and zoning. This email covers questions about floodplain functions, 18 – 23. The Port previously responded to question 19 on January 16, 2013.

Floodplain Functions
There is no requirement that the Port and City achieve a net gain in ecological function. The Community Working Group developed evaluation principles to inform and shape discussions. The WHI Advisory Committee also played homage to the 11 principles without ever using them to assess the annexation proposal. The 11 principles are as follows.

- A net increase in ecosystem function.
- A positive contribution to regional economic health
- An economically viable port facility.
- A positive contribution to the local community
- An addition to, not competition with, the regional port system.
- Public access opportunities to West Hayden Island.
- Sustainable scale for any use included as part of the option.
- Flexibility to accommodate the unknown future.
- Taking advantage of the unique aspects and opportunities of the site.
- Consideration of impacts on multiple time periods i.e. current, mid-range, and future.
- Consideration of impacts on multiple geographies, i.e. local, sub-regional, and regional levels.

Eight hundred acres of the site are likely to be effected by actions taken after the annexation and zoning of the entire parcel. Land management and mitigation activities will result in increased floodplain function on the 500 acres of open space. Of the three hundred acre future development site, major portions are already above the base flood elevation or no longer subject to flooding (the dredge material handling area; 104 acres).

That said, impacts to floodplain function will be assessed at the time of federal permitting as described in responses to question 19 regarding consultation requirements for development in the floodplain.

In the Portland metro area, through Title 24, there is one regulation applied to floodplains and one regulation applied to floodways for risk management: balanced cut and fill and no-net-rise. Balanced cut and fill requirements are intended to maintain flood

storage capacity and apply to the Metro Title 3 Flood Management Areas in Portland. The no-net-rise standard, which is intended to protect property from increased flooding, is applied to all development located in the floodway and will be applied to WHI development.

Through Metro's Title 3, when a floodplain is filled, another area in the floodplain must be taken away in an equal amount to keep the flood storage amount the same. When Metro updated Title 3, they recognized that there was a shortage of available locations for marine terminal development; that marine-related structures are necessarily located in floodplains; and that in large river systems, especially ones regulated by dams, flood storage is less dependent upon small patches of floodplain for storage. Metro exempted a portion of West Hayden Island from cut-and-fill requirements. It has therefore been determined that filling at this location will not cause harm to property, safety, or human health (See the attached for additional information about technical floodplain issues).

Future mitigation on WHI and Government Island will result in increased floodplain function, including flood storage, nutrient cycling, channel function and others.

Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.

MEMO

DATE: October 29, 2012

TO: Susie Lahsene, Port of Portland

FROM: Eric Engstrom, Bureau of Planning and Sustainability

CC: Mindy Brooks, Bureau of Planning and Sustainability
Phil Nameny, Bureau of Planning and Sustainability
Doug Morgan, Bureau of Development Services
Mike Rose, Bureau of Environmental Services

SUBJECT: Floodplain Regulations in Portland

This is in response to your memo WHI Floodplain Summary, October 11, 2012. Staff have reviewed the memo. Below is an explanation of how the City regulates almost all of the floodplains in Portland for both risk management and natural resource functions.

Through Title 24, there are two regulations applied to floodplains for risk management: balanced cut and fill and no-net-rise. Balanced cut and fill requirements are intended to maintain flood storage capacity and apply to the Metro Title 3 Flood Management Areas in Portland. The no-net-rise standard, which is intended to protect property from increased flooding, is applied to all development located in the floodway.

In addition, almost all undeveloped floodplains in Portland have environmental or greenway overlays applied to them. These overlays recognize the multiple natural resource functions provided by the floodplain, including not only flood storage but also nutrient cycling, channel functions, etc. During the recent River Plan North Reach project, staff recommended and City Council approved continued management of the Willamette River floodplain for natural resource functions by applying the river-e overlay zone to undeveloped portions of the floodplain. The overlay was not recommended for developed floodplain where the only function provided is flood storage and no other riparian corridor or wildlife habitat functions are provided. This represented little of the floodplain in the North Reach. Further, where the overlay zone was not recommended, balanced cut and fill and no-net-rise requirements still apply.

When Metro updated Title 3 for the region, a decision was made to not require balanced cut and fill for development within a specific footprint on West Hayden Island (WHI). The purpose of this exemption was to facilitate marine terminal development.

Through the Hayden Island Natural Resources Inventory, the City identified multiple riparian corridor functions provided by the undeveloped floodplain on WHI. In the Economic, Social, Environmental and Energy (ESEE) Analysis the City is not recommending application of environmental regulations to the undeveloped floodplain in the proposed IH zone, which is an exception to the typical policy of applying environmental regulations to undeveloped floodplain. The WHI ESEE recommendation follows the regional policy decision of Title 3 and is based on the economic benefits of a deep-water marine terminal and rail loop configuration that is unique to WHI.

Therefore, if the WHI plan is approved as currently written, development of marine terminal facilities on WHI would only need to address the no-net-rise requirements, not balanced cut and fill or other natural resource functions provided by the floodplain.

It should be noted that this memo addresses only local regulations. During a future NEPA process, the Port may have to address floodplain functions as they relate to federally-listed ESA species.

From: Theisen, Greg [Greg.Theisen@portofportland.com]
Sent: Thursday, January 24, 2013 5:25 PM
To: Brooks, Mindy (Planning); Hoy, Rachael; Nameny, Phil (PLN); Engstrom, Eric (Planning)
Cc: Lahsene, Susie; Harrison, Marla; Green, Dana; Whitlock, Ian
Subject: WHI PSC Qs Natural Resources 24-26

Attachments: Mitigation_Floodplain_Process_ClimateChange.docx

Mindy et.al.,

I have attached correspondence from the Port, dated November 2012 that covers most of questions 19-27. This email focuses on questions 24—26.

CLIMATE CHANGE
A study was conducted that compiled numerous model outputs for climate change and it clearly showed that there would be less flooding over time. This seems contradictory to City expressed concerns with the issue. If there is debate around these issues please fairly communicate that debate.
Back in 2008/2009 the WHI work process covered climate change impacts. Consistent and neutral communication around this issue is important. For example, p26 (1/22/2013, PSC Questions and Staff Response, Attachment B) states *"Changes in precipitation patterns could cause additional river flooding…"* A more neutral and accurate statement would be "Changes in precipitation patterns could cause less flooding, no change in flooding or additional flooding" since just prior to this statement the (un)certainties are detailed. And following the quoted statement the human based river management element is mentioned as also affecting the flood regime under climate change conditions.

Climate Change (From prior Port submittals, see attached)
In a 2010 study performed by the Climate Impacts Group (University of Washington) for the Pacific Northwest comparing 30 different climate change models and predicting out to 2080, the following information was developed for the Columbia at Vancouver, WA:

- Temperature:
  - Temperature will rise but the amount is dependent on the amount of greenhouse gases in the atmosphere
  - The rate of temperature change will increase
  - Low temperatures that we know now will occur less frequently
  - All seasons will be warmer with the highest temperature increases in the summer
  - The snowpack in the mountains will be less
  - Increases in temperature will exceed the variability of the last century—possibly exceeding the adaptability of species, ecosystems, and built infrastructure
- Precipitation:
  - Change in average annual rainfall is 0 inches
  - Rainfall numbers are not as dependent on greenhouse gas emissions
  - Rainfall is more dependent upon variable less well known, such as ocean currents
  - Snow will be replaced by rain due to warming
  - Possibly more rain in winter and less in the summer
  - Average annual rainfall won't change but the intensity of the events may change
- Flooding:
  - Flood stage at or below historic levels at Hayden Island
  - One exception in the year 2080 for 100 year storm where the mean is slightly above the historic level

To sum up, it will be warmer, especially in the summer, the precipitation amount won't change but it may be wetter in the winter and dryer in the summer with the possibility of more intense storms, and flooding at West Hayden Island is predicted to be less than historic levels. This research also provided data that is extremely relevant to the project site--i.e. the Vancouver tide gauge.

MITIGATION FOR DEVELOPMENT IMPACTS

All parties agree that natural resource mitigation should cover impacts for the entire development footprint, including impacts in the water. This is a conservative approach because at this time, there are no plans for development and it is not known if or to what extent the entire footprint will be affected.

Below is a discussion on the four habitat types for which mitigation is required:

Forest:
Mitigation of less than 150 acres of forest impact is required by the City of Portland. The amount of and criteria for the mitigation has been calculated using a City model that equates to 110% replacement for the loss on West Hayden Island. The City is requiring the replacement of 100-yr old forest with a 100-year old forest. In addition, factors are added for distance from the site of impact, time of replacement to create a 100 year old forest, and the type of mitigation. This results in the following:

- Impact: less than 150 acres
- City's model calculation of mitigation and IGA requirement:
    - 615 acres of mitigation for trees on West Hayden Island and Government Island
    - $4.1 million dollars to the City to do forest mitigation
    - $5.6 million dollars to the City for planting, maintaining, and performing 100 years of monitoring on West Hayden Island and Government Island

Wetlands:
The development footprint will impact 10.2 acres of wetlands. Consultants have reviewed this impact, developed potential projects that can be completed on-site, and believe that state and federal regulators will require approximately 19 acres of mitigation according to the methods currently used. This could change by the time development may occur and this number may increase. The development would provide whatever is required by state and federal regulators at the time. In the City's last version of the IGA, the City would have a seat at the table with the state and federal regulators during the permitting process and a minimum of 30 acres of wetlands would be required. At approximately $250K/acre to construct, this amounts to an extra $2.75 million dollars over and above the $9.3 million dollar project already proposed on the north shore of the island.

- Impact: 10.2 acres
- State and federal mitigation requirement: Approximately 19 acres and $9.3 M for project
- City requirement: Minimum 30 acres and extra $2.75 M and a seat at the table

Shallow Water:
Approximately 0.3 acres shallow water habitat will be impacted when dock construction may occur. The Corps, Oregon Department of State Lands, NOAA Fisheries, and US Fish and Wildlife are the primary state and federal agencies that regulate these waters for the purposes of navigational servitude and for the Endangered Species Act. The City too has jurisdiction, however their charge is less explicit.

- Impact: 0.3 acres
- State and federal mitigation requirement: Estimated 1 acre, included in $9.3 M project for wetlands
- City requirement: Minimum 5 acres, extra $7.6 M and a seat at the table

Grassland:
No grassland is listed in the City's Natural Resource Inventory for West Hayden Island. The City is requiring a $1.5 million dollar grant for grassland mitigation and for meadowlark habitat. The area for which the City is requiring mitigation is the Dredged Material Placement Site and some roads. The Dredged Material Placement Site is an authorized activity that has significantly altered the character of the site. On other port property, this type of site was not regulated in such a way by the City.

- Impact: 0 acres of grassland, 123 acres of barren weedy fill, dredged material placement site, and roads
- City requirement: $1.5 M for grant to the City to complete a grassland project

Future Regulatory Processes
Should development occur on West Hayden Island, additional permitting will be required. Local permitting will be triggered by events spelled out in the IGA, which is being finalized. State and federal permitting will be triggered when a state or federal resource is proposed to be impacted—in this case a wetland or soil below Ordinary High Water. At that time, the project would need to submit 35% design drawings along with an application, biological assessment, cultural resources survey, and other accompanying documents. This also triggers the National Environmental Policy Act (NEPA).

The Army Corps of Engineers will likely be the lead federal agency and may require mitigation to ensure a favorable outcome of the EIS. Numerous state and federal agencies will also be involved.

All of these processes are publicly noticed and have a robust public component—especially NEPA. These processes are lengthy—roughly three to five years. It should be noted that there may be multiple permits for a development projects over several years and that the NEPA document, an Environmental Impact Statement (EIS), may need to be updated. A public process occurs at the time of significant updates as well. All of the permits and the EIS must analyze the cumulative, interrelated and interdependent impacts associated with the overall project that are known at the time. Also of note is that no development action can be taken prior to issuance of a Record of Decision followed by a mandatory 45 day appeal process.

The EIS will necessarily address the following:

- Fish and wildlife, including threatened and endangered species and their critical habitats
- Effect on subsistence activities if any
- Hydrology and wetlands
- Noise
- Air and water quality
- Socioeconomics including a Health Impact Assessment
- Cultural Resources
- Secondary and cumulative impacts
- Climate change; and
- Other significant issues raised by the public and agencies during the comment period

Floodplain

A floodplain is defined as a plain bordering a river and overflowed at a time of high water. FEMA is the federal agency that maps the areas that are regulated a floodplains and determine what can be done in these flooplains to protect property, safety, and human health. NOAA Fisheries has won a suit against FEMA which now requires FEMA to consider endangered species impacts in the floodplain. The City and others point out that floodplains offer additional ecosystem functions such as nutrient cycling, habitat for other species, aesthetics, and other functions as discussed in the City's Natural Resource Inventory.

In the Portland metro area, through Metro's Title 3, when a floodplain is filled, another area in the floodplain must be taken away in an equal amount to keep the flood storage amount the same. When Metro updated Title 3, they presumably recognized that there was a shortage of available locations for marine terminal development; that marine-related structures are necessarily located in floodplains; and that in large river systems, especially ones regulated by dams, flood storage is less dependent upon small patches of floodplain for storage. Metro exempted a portion of West Hayden Island from cut-and-fill requirements. It has therefore been determined that filling at this location will not cause harm to property, safety, or human health. The City, through Title 24, requires something similar, but different, and is called no net rise in the floodway. The development would comply with the City's requirement.

The NOAA Fisheries requirements that would be imposed through FEMA will be more directly applied at this site. All development actions would go through consultation with NOAA Fisheries. Therefore, their requirement specific to this location will be passed to the development through a binding Biological Opinion that is part of a permit issued by the US Army Corps of Engineers.

The ecosystem functions offered by the floodplain are in part being addressed by mitigation of wetlands and shallow water habitat on-site, more than making up for these lost resources. Wetlands are the areas used most for storage and used for aquatic and terrestrial species. In addition, the ESEE process was done by the City to specifically to value ecosystem functions and values. The floodplain in the development footprint did not obtain a high rank in this process.

Climate Change

Climate change is still debated in the press; however, in the scientific community climate change is accepted as our future. In a 2010 study performed by the Climate Impacts Group (University of Washington) for the Pacific Northwest comparing 30 different climate change models and predicting out to 2080, the following information was developed for the Columbia at Vancouver:

- Temperature:
    - Temperature will rise but the amount is dependent on the amount of greenhouse gases in the atmosphere
    - The rate of temperature change will increase
    - Low temperatures that we know now will occur less frequently
    - All seasons will be warmer with the highest temperature increases in the summer
    - The snowpack in the mountains will be less
    - Increases in temperature will exceed the variability of the last century—possibly exceeding the adaptability of species, ecosystems, and built infrastructure
- Precipitation:

    - Change in average annual rainfall is 0 inches
    - Rainfall numbers are not as dependent on greenhouse gas emissions
    - Rainfall is more dependent upon variable less well known, such as ocean currents
    - Snow will be replaced by rain due to warming
    - Possibly more rain in winter and less in the summer
    - Average annual rainfall won't change but the intensity of the events may change
- Flooding:
    - Flood stage at or below historic levels at Hayden Island
    - One exception in the year 2080 for 100 year storm where the mean is slightly above the historic level

To sum up, it will be warmer especially in the summer, the precipitation amount won't change but it may be wetter in the winter and dryer in the summer with the possibility of more intense storms, and flooding at West Hayden Island is predicted to be less than historic levels.

Brooks, Mindy (Planning)

From: Theisen, Greg [Greg.Theisen@portofportland.com]
Sent: Friday, January 25, 2013 2:46 PM
To: Brooks, Mindy (Planning); Engstrom, Eric (Planning); Hoy, Rachael; Nameny, Phil (PLN)
Cc: Lahsene, Susie
Subject: FW: Hydrology information
Attachments: vanw.graphs.pdf; vanw_50percentHydrograph.pdf

Mindy, Eric et.al.,

This is something we sent you back in August. I think it is helpful in responding to the floodplain questions and is also relevant when discussing vegetation types and site function when it comes to flood inundation and occurrence. Call me if you want to discuss how to package this for PSC.

From August 2012:
We asked our consultant, Joe Krieter, Environ, to take a rather quick look at the elevations of the forested impact area relative to the hydrograph at the Vancouver tide gauge. As Dave Helzer mentioned yesterday in our meeting, it is not a direct correlation that elevation and river stage equate to inundation levels; however, it is a fairly good and generous surrogate. Typically, physical features slow the reach of water to a particular elevation and so, in using river level as a surrogate for water level on the land, this likely produces a greater frequency with higher wetted elevations than a more rigorous approach.

If you have any questions regarding this information please contact me.
Thank you.
Marla

Below is Joe Krieter's e-mail (along with attachments):

> As discussed this morning; here is my GIS/river stage assessment for the forested impact area on WHI. The NAVD 88 elevations in meters for the site are:
>
> Max: 12.39
> Min: 4.52
> Mean: 7.32
>
> For details please look at the message from Erica McCormick below as she provided stats for the light blue area shown in her screen grab.
>
> Converted for you to Columbia River Datum in feet:
>
> Max: 35.5
> Min: 9.7
> Mean: 18.9
>
> The maximum flood event on record which was > than a 100 year storm (less than a 1% chance of occurrence) was 27.2 feet CRD. The corresponding annual exceedance for minimum daily annual stage and the minimum site elevation (9.7 feet CRD) is approximately 10% (or roughly equivalent to a 10 year event). The corresponding annual exceedance for minimum daily annual stage and the average site elevation (18.9 feet CRD) is also less than 1% (also greater than a 100 year event).
>
> Based on our conversation this morning, based on the Vancouver gauge data from 1972 through 2011, is seems fair to say that it would take a 10 year event to reach the minimum elevations at the site and a 100 year event to flood the site (the light blue area shown below). Dana is correct in that the 100 flood stage is considered to be 16.0 feet CRD; which is consistent with our stage exceedance status.
>
> A really good summary of how to interpret probability of exceedance stats is provided on this USGS site:
>
> http://ga.water.usgs.gov/edu/100yearflood.html
>
> Hope this helps,
>
> Joe
>
> Office: 503-353-1734

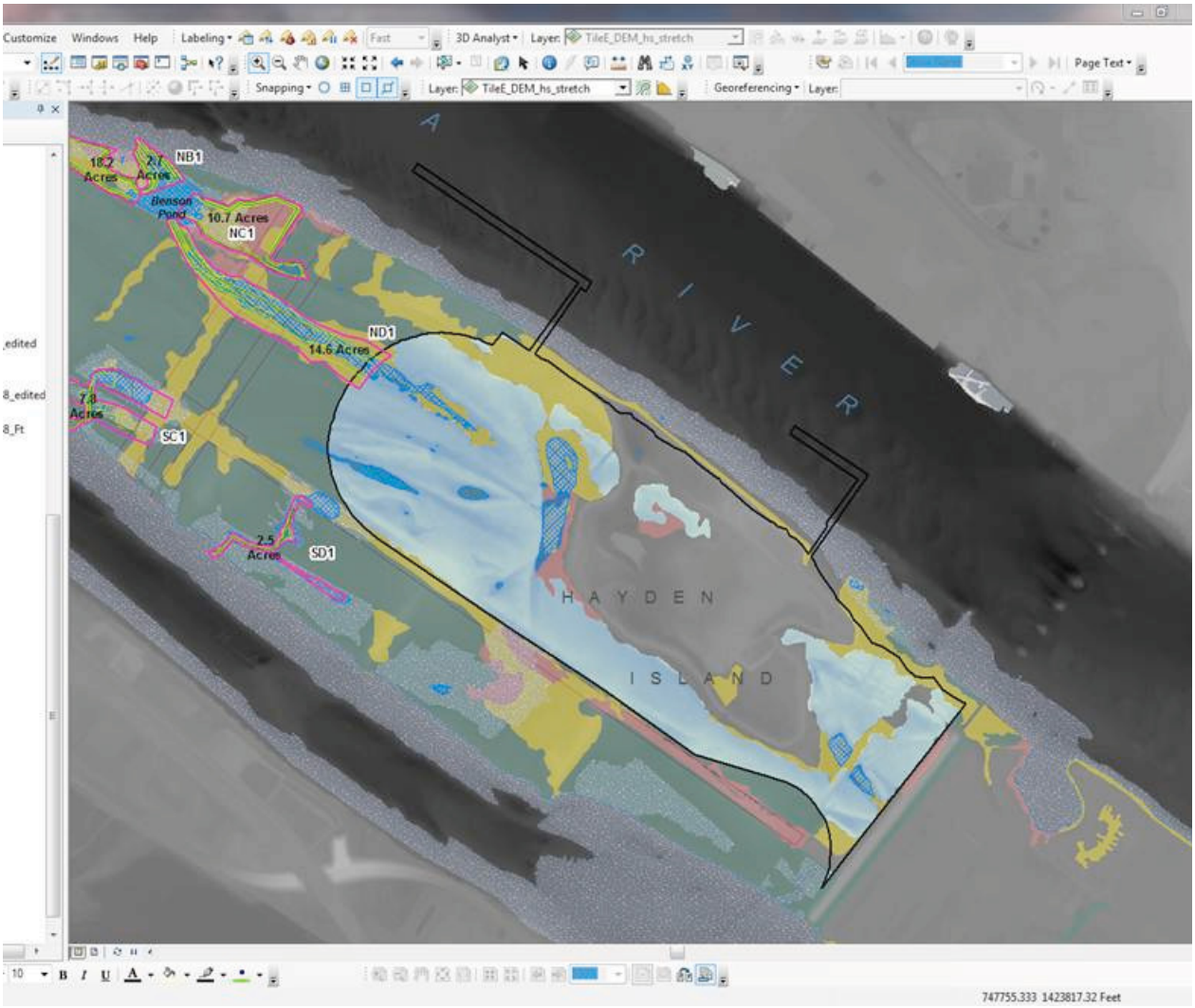
Cell: 503-407-1995

From: Erica McCormick
Sent: Wednesday, May 30, 2012 10:01 AM
To: Joe Krieter
Subject: elevations

For the upland forested areas in the final concept design footprint:

Max: 12.39
Min: 4.52
Mean: 7.32
Std Dev: 1.09

Clipped to footprint, extracted LiDAR by mask.



Erica D. McCormick, M.Sc., RPA | GIS Analyst
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Clackamas, Oregon
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f: 503.353.1653
e: emccormick@environcorp.com
http://www.environcorp.com

From: Brooks, Mindy (Planning) [mailto:Mindy.Brooks@portlandoregon.gov]
Sent: Tuesday, August 07, 2012 10:12 AM
To: Harrison, Marla; Imperati, Sam
Cc: Lahsene, Susie; Theisen, Greg; Green, Dana; Engstrom, Eric (Planning); Rosen, Mike; Helzer, David
Subject: RE: Hydrology information

Hi – This is the last email I received regarding Gov. Is. hydrology. I looked through all my email boxes and didn't see anything with data attached. Would you send that information over? And cc' Dave Helzer.

Thanks

(PS - Sorry about missing the meeting yesterday afternoon. We are having some family medical issues right now.)

~~~~~~~~~~~~~~~~~~

Mindy

From: Harrison, Marla [mailto:Marla.Harrison@portofportland.com]
Sent: Friday, July 27, 2012 5:43 PM
To: Brooks, Mindy (Planning); Imperati, Sam
Cc: Lahsene, Susie; Theisen, Greg; Green, Dana
Subject: Hydrology information

Mindy,
I was hoping to send you information regarding the inundation regime on WHI this week. Due to conflicting priorities, I was unable to get that out this week. I will provide that information next week along with additional comments on the City's framework. Will we be receiving responses to the questions I asked about the framework soon?
I presume that I should continue to coordinate through you. If this is not the case, please let me know.
Thank you.
Marla

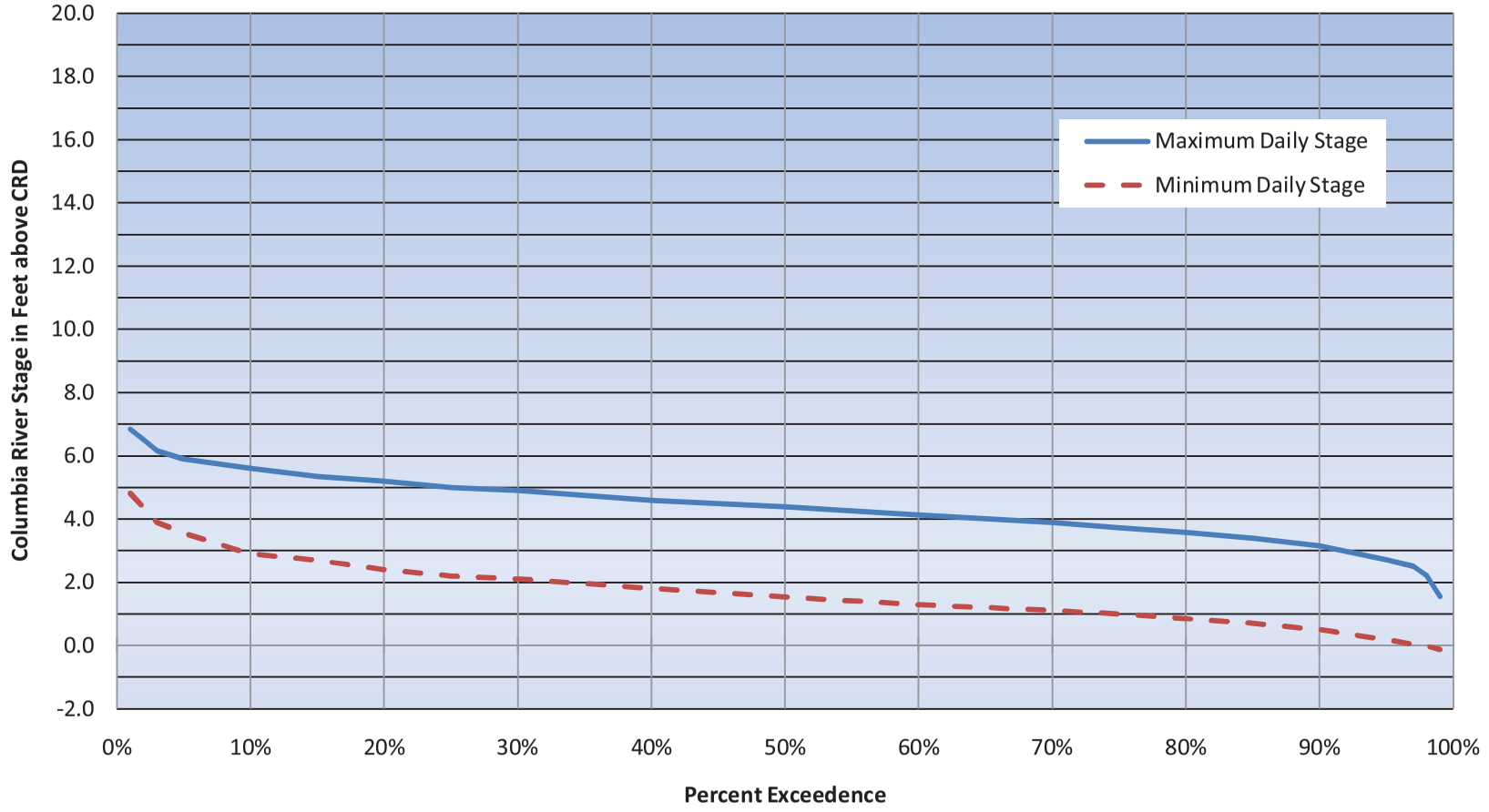
Marla Harrison
Port of Portland
503.415.6833
C: 503.679.9485
~~~~~~~~~~~~~~~~~~

Monthly River Stage Exceedance
Columbia River at Vancouver, WA Gauges VANW and VANP

Month	Daily	River Stage in Feet, Columbia River Datum									
		Max	Percent Exceedance								Min
			1%	5%	10%	25%	50%	75%	90%	95%	99%	
Oct	Max	7.8	6.8	5.9	5.6	5.0	4.4	3.7	3.2	2.7	1.6	
	Min		4.8	3.6	2.9	2.2	1.5	1.0	0.5	0.2	-0.1	-0.50
Nov	Max	19.4	10.7	8.7	7.8	6.5	5.4	4.5	3.9	3.4	2.6	
	Min		9.6	7.4	6.2	4.3	3.0	2.1	1.5	1.2	0.5	-0.42
Dec	Max	18.5	16.4	12.5	10.6	8.2	6.7	5.6	4.8	4.4	3.5	
	Min		15.3	11.6	9.6	7.0	5.0	3.5	2.4	2.0	1.3	0.72
Jan	Max	23.4	17.8	13.2	11.3	9.0	7.2	5.9	5.2	4.6	3.7	
	Min		17.5	12.2	10.4	7.8	5.6	4.1	3.0	2.5	1.7	0.70
Feb	Max	27.2	19.0	13.7	11.0	8.5	6.7	5.5	4.8	4.5	3.8	
	Min		17.9	13.1	10.0	7.2	5.1	3.3	2.4	1.9	1.4	0.80
Mar	Max	15.8	15.1	13.1	11.0	8.6	6.7	5.4	4.6	4.2	3.4	
	Min		14.6	12.0	10.2	7.5	5.0	3.3	2.4	1.9	1.4	0.14
Apr	Max	17.8	16.0	12.1	11.0	8.8	6.9	5.5	4.4	4.0	3.3	
	Min		15.1	11.4	10.1	7.8	5.5	3.8	2.6	1.8	0.9	0.40
May	Max	17.9	16.9	14.5	13.0	10.2	8.3	6.8	5.6	5.0	4.2	
	Min		16.4	14.1	12.4	9.6	7.1	5.5	4.0	2.8	1.7	-0.01
Jun	Max	21.1	19.3	16.1	13.8	11.1	8.4	6.1	4.9	4.5	3.7	
	Min		18.9	15.6	13.3	10.3	7.4	4.4	2.5	2.0	0.8	-0.01
Jul	Max	17.9	13.2	9.2	8.1	6.8	5.7	4.8	4.0	3.6	2.5	
	Min		12.9	8.1	6.9	5.2	3.2	2.1	1.0	0.5	-0.2	-0.74
Aug	Max	8.1	7.4	6.5	6.0	5.5	4.8	4.2	3.7	3.2	2.2	
	Min		6.1	5.0	4.2	2.9	1.9	1.1	0.6	0.4	0.1	-0.01
Sep	Max	7.9	6.4	5.7	5.3	4.8	4.3	3.7	3.2	2.9	1.3	
	Min		4.6	3.2	2.6	1.9	1.3	0.7	0.3	0.1	-0.3	-0.70
Annual	Max	27.2	16.6	12.5	10.4	7.9	6.0	4.7	4.0	3.5	2.6	
	Min		16.0	11.7	9.5	6.6	4.0	2.1	1.1	0.7	0.1	-0.74

NOTES:
1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
4. Columbia River Datum at River Mile 106.4 is 5.25 feet above NAVD 1988 and at River Mile 103.8 is 5.10 feet above NAVD 1988.

October
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP

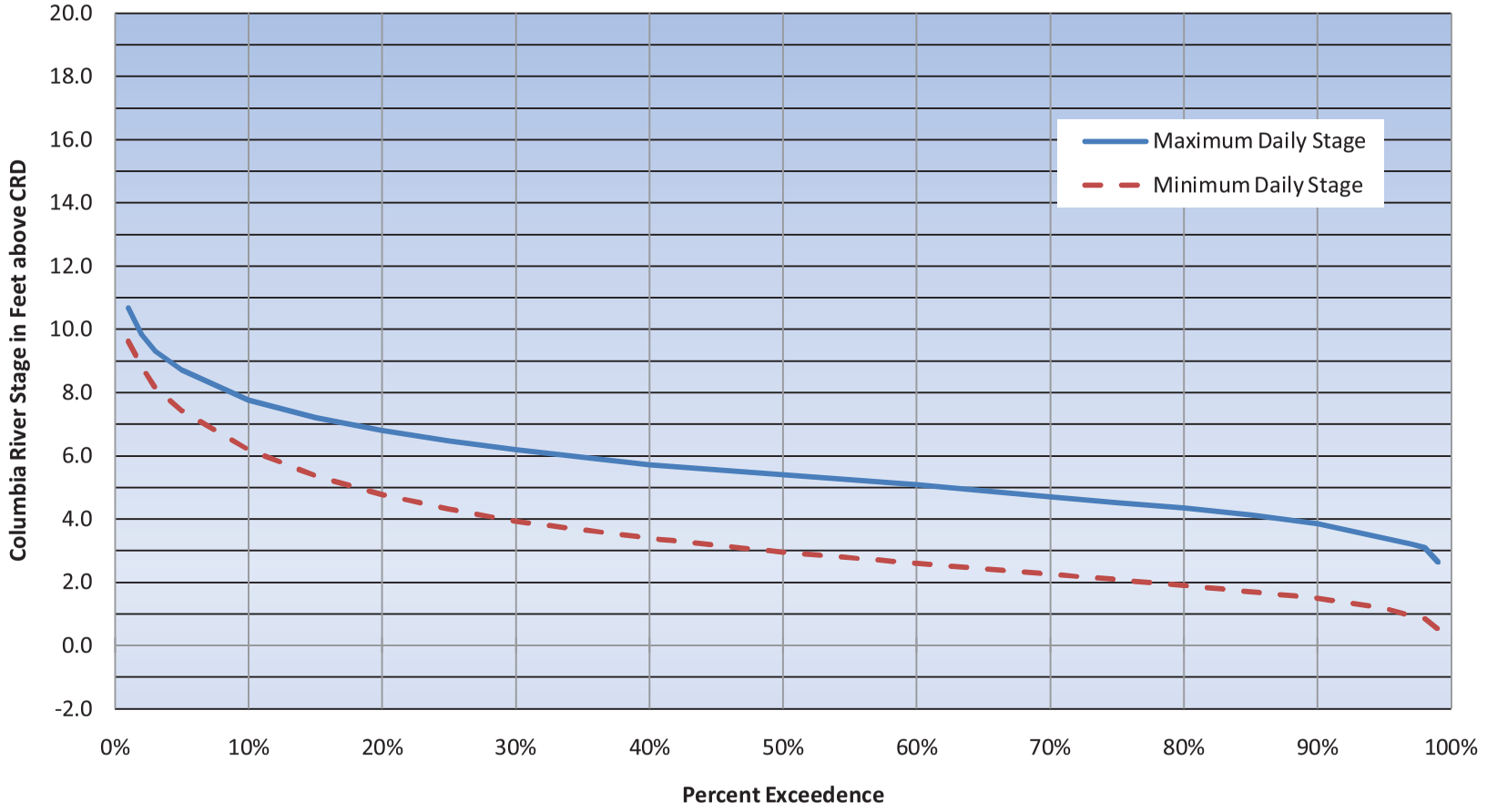


Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
4. Columbia River datum at River Mile 106.4 is 5.25 feet above NAVD 1988 and at River Mile 103.8 is 5.10 feet above NAVD 1988.

Parsons Brinckerhoff
11/16/2011

November
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
4. Columbia River datum at River Mile 106.4 is 5.25 feet above NAVD 1988 and at River Mile 103.8 is 5.10 feet above NAVD 1988.

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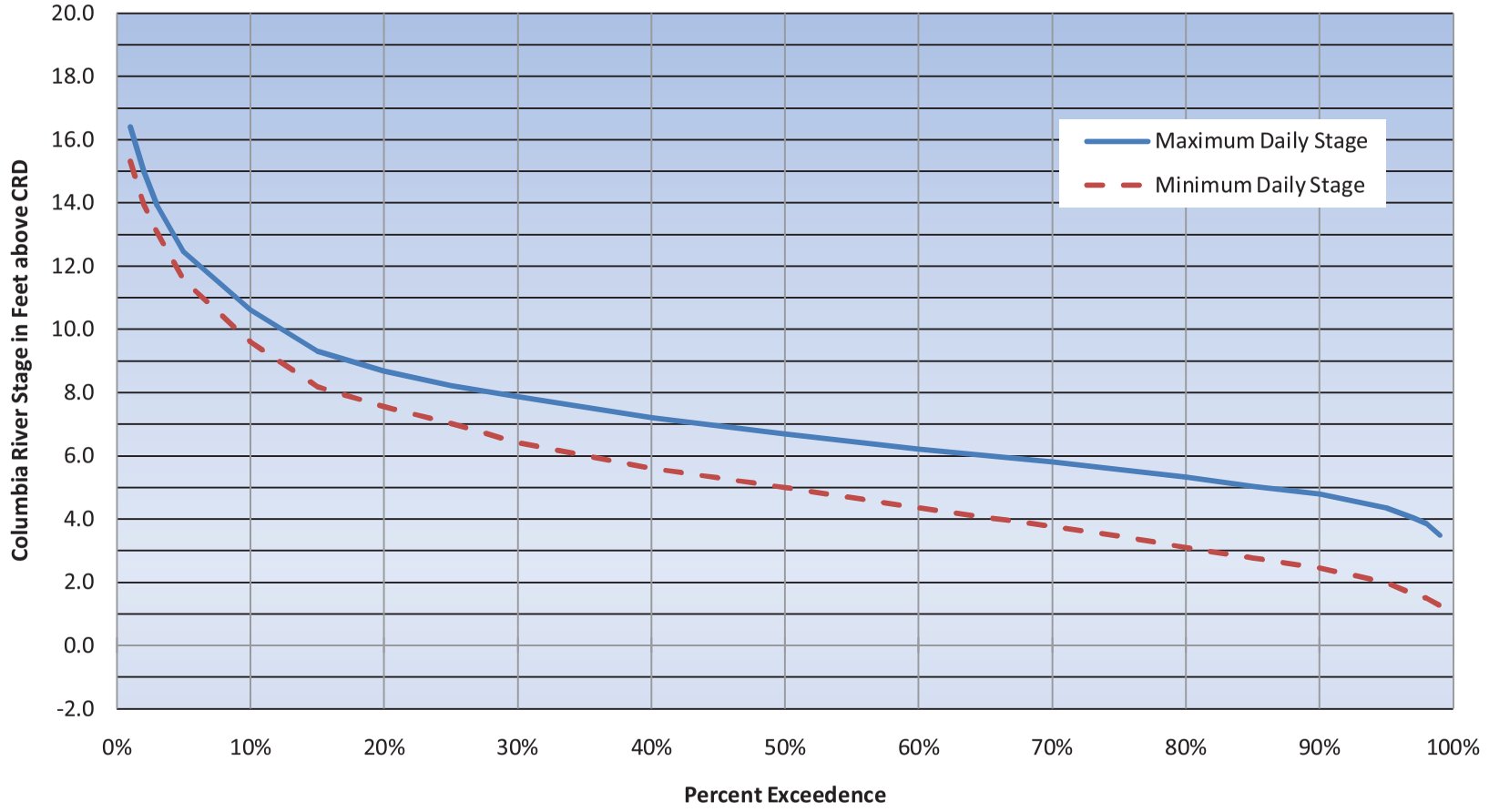
December
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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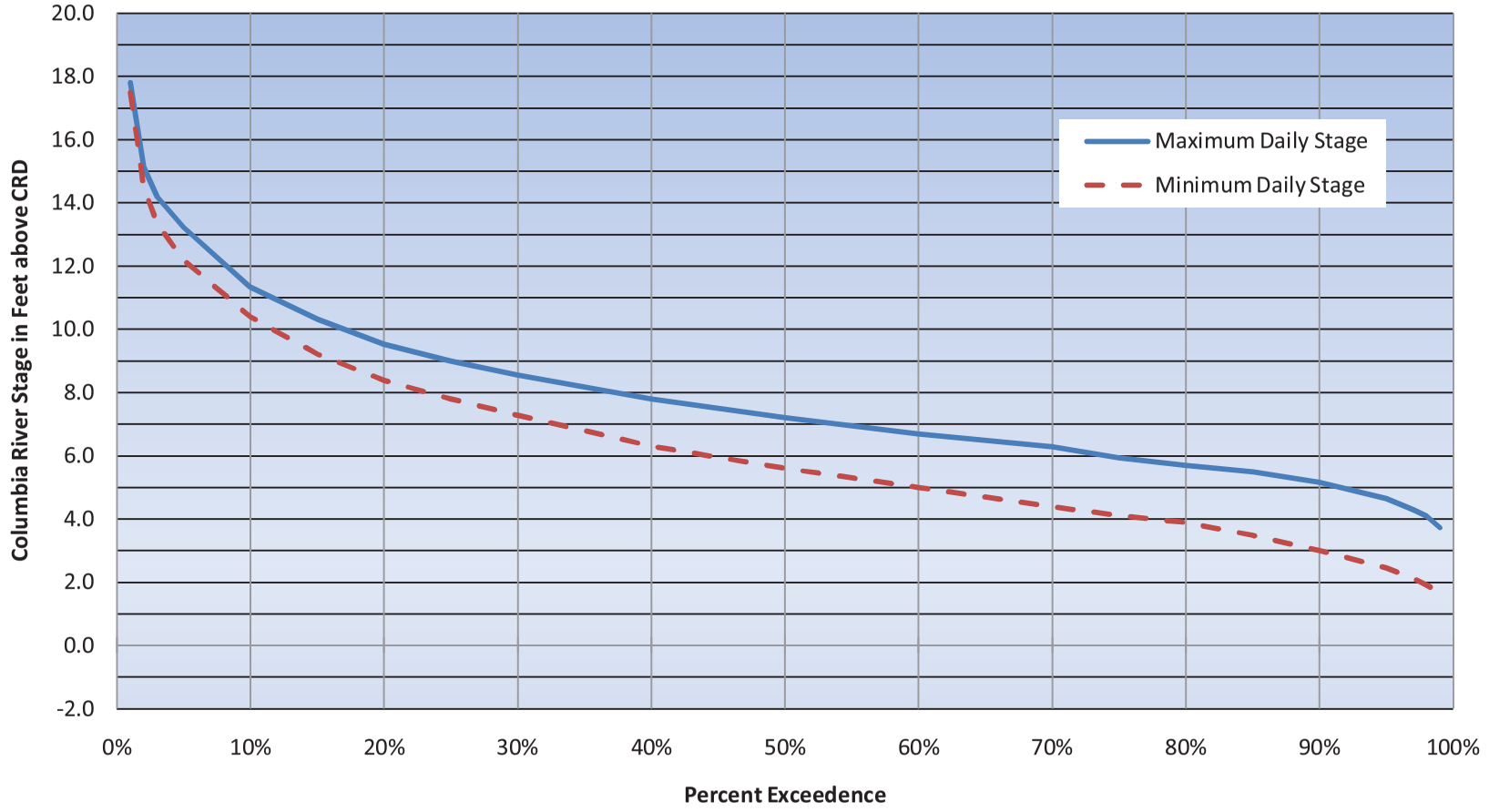
January
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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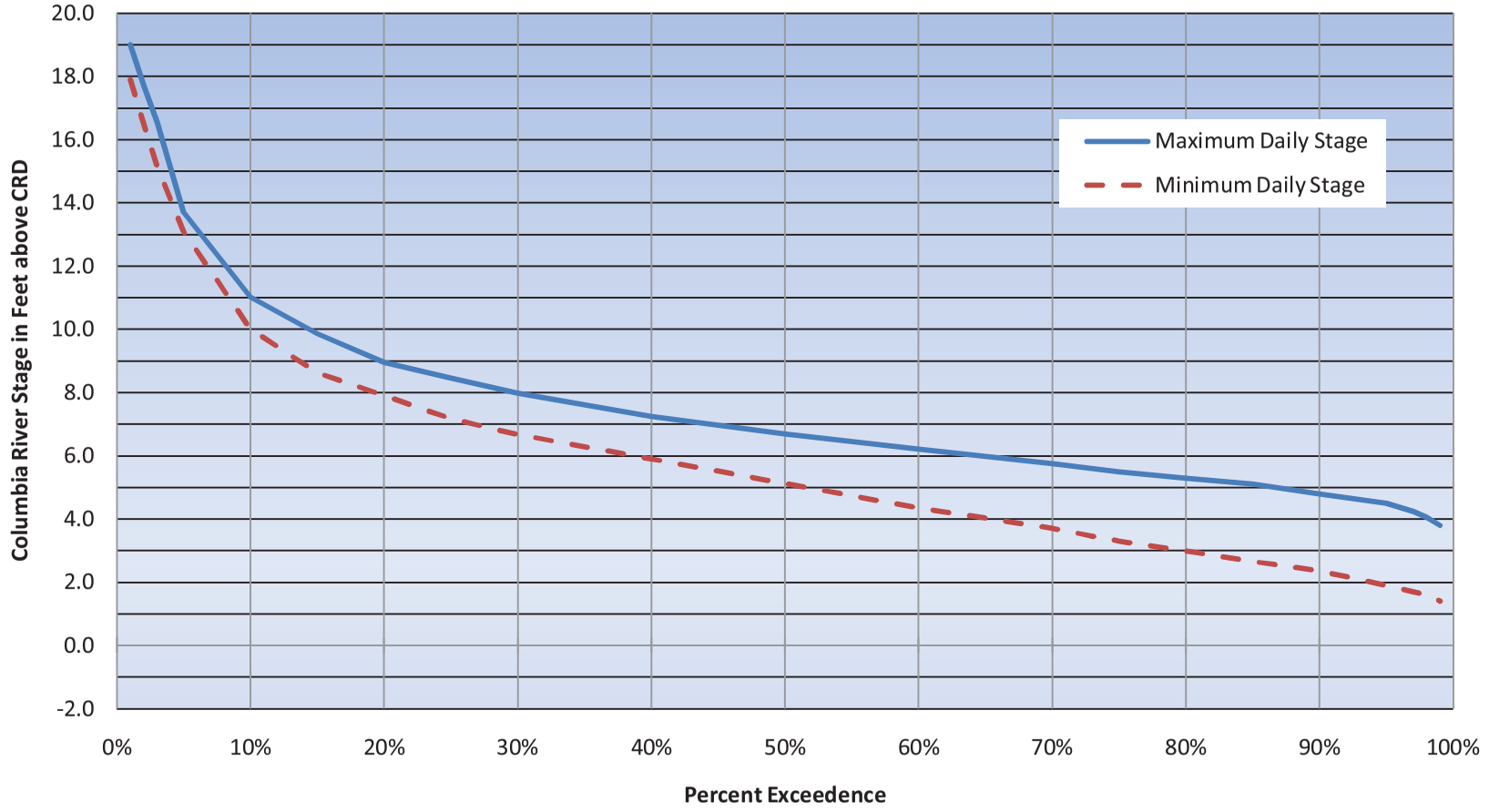
11/16/2011

February
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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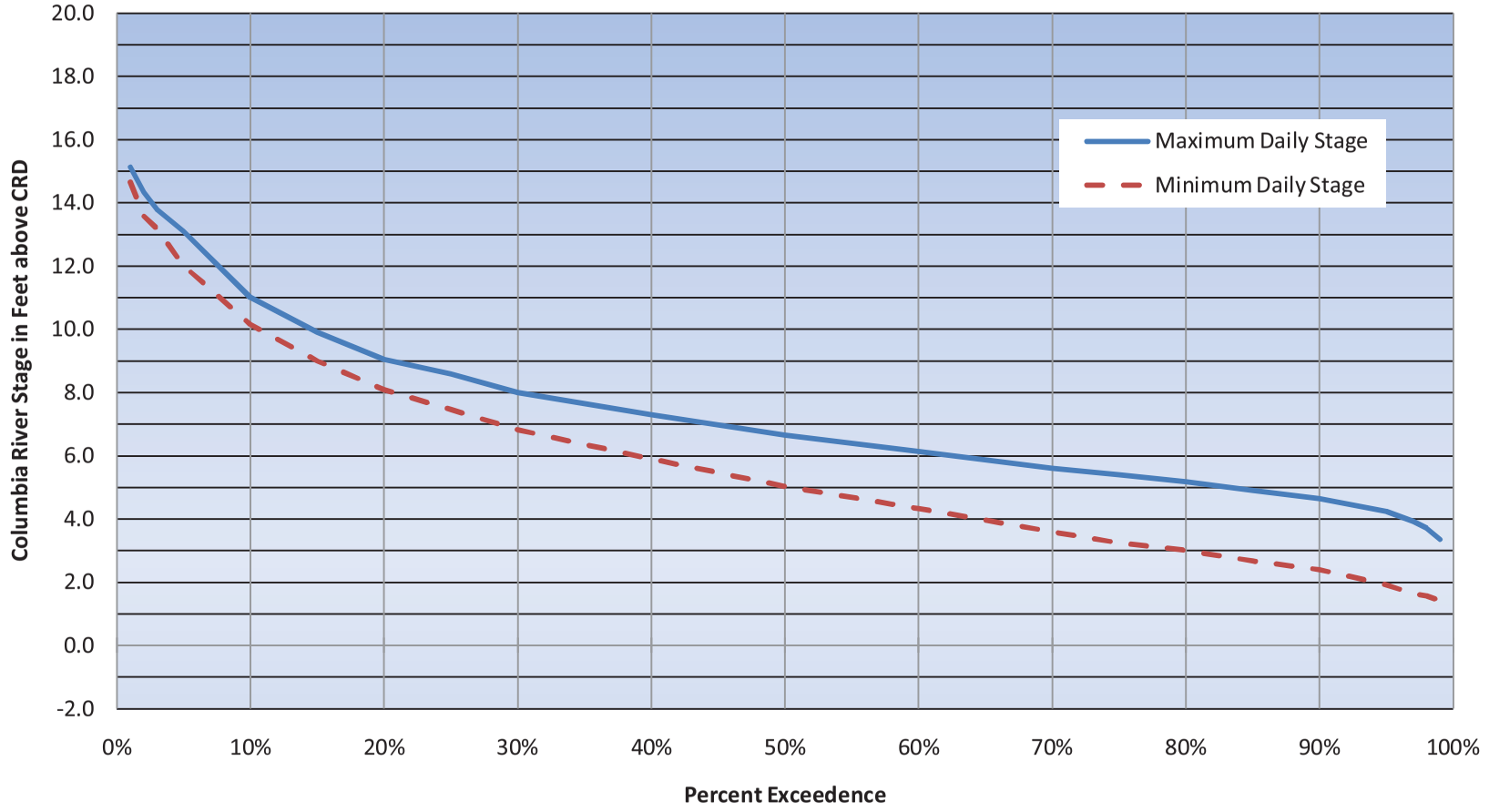
March
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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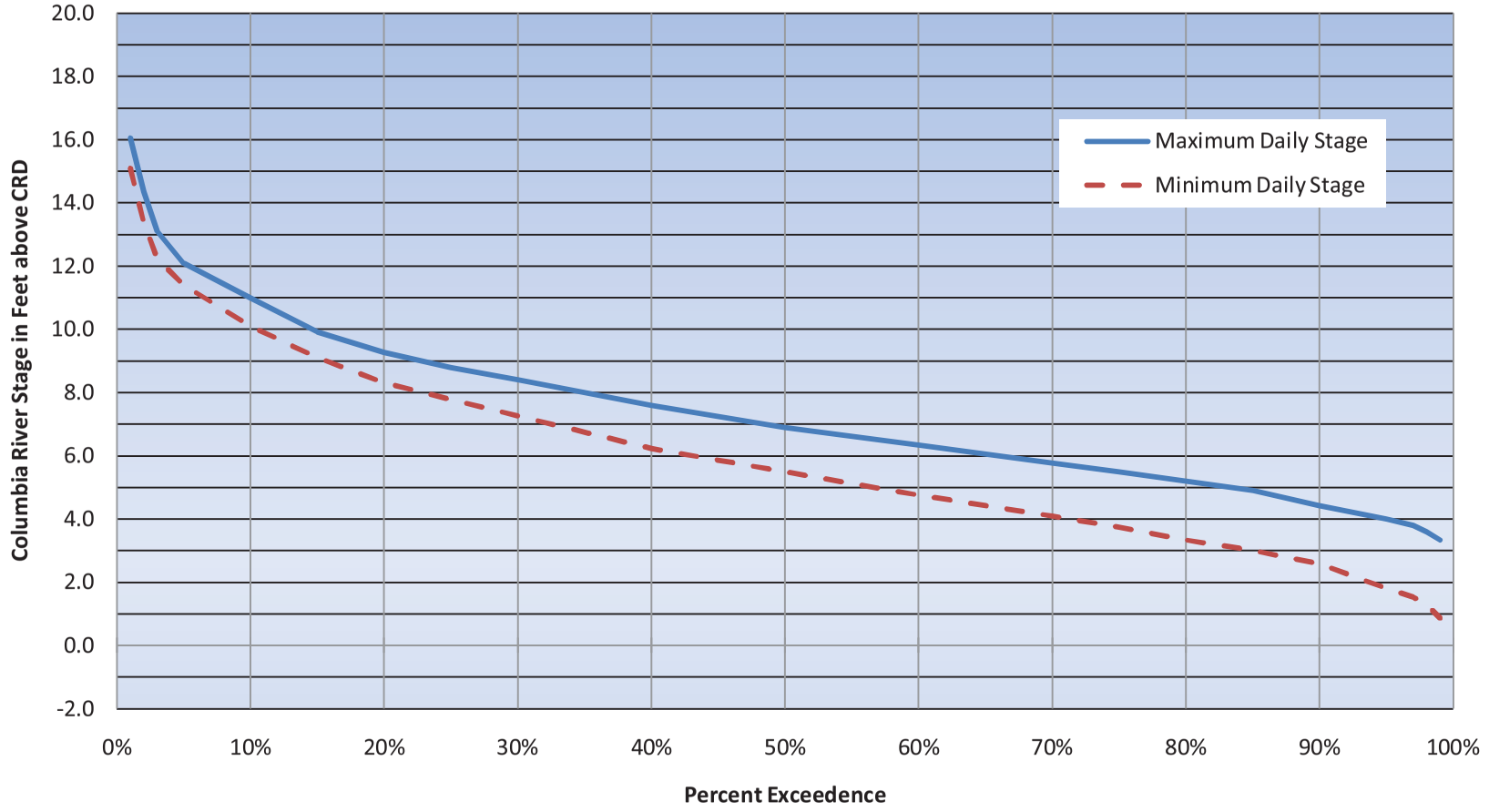
April
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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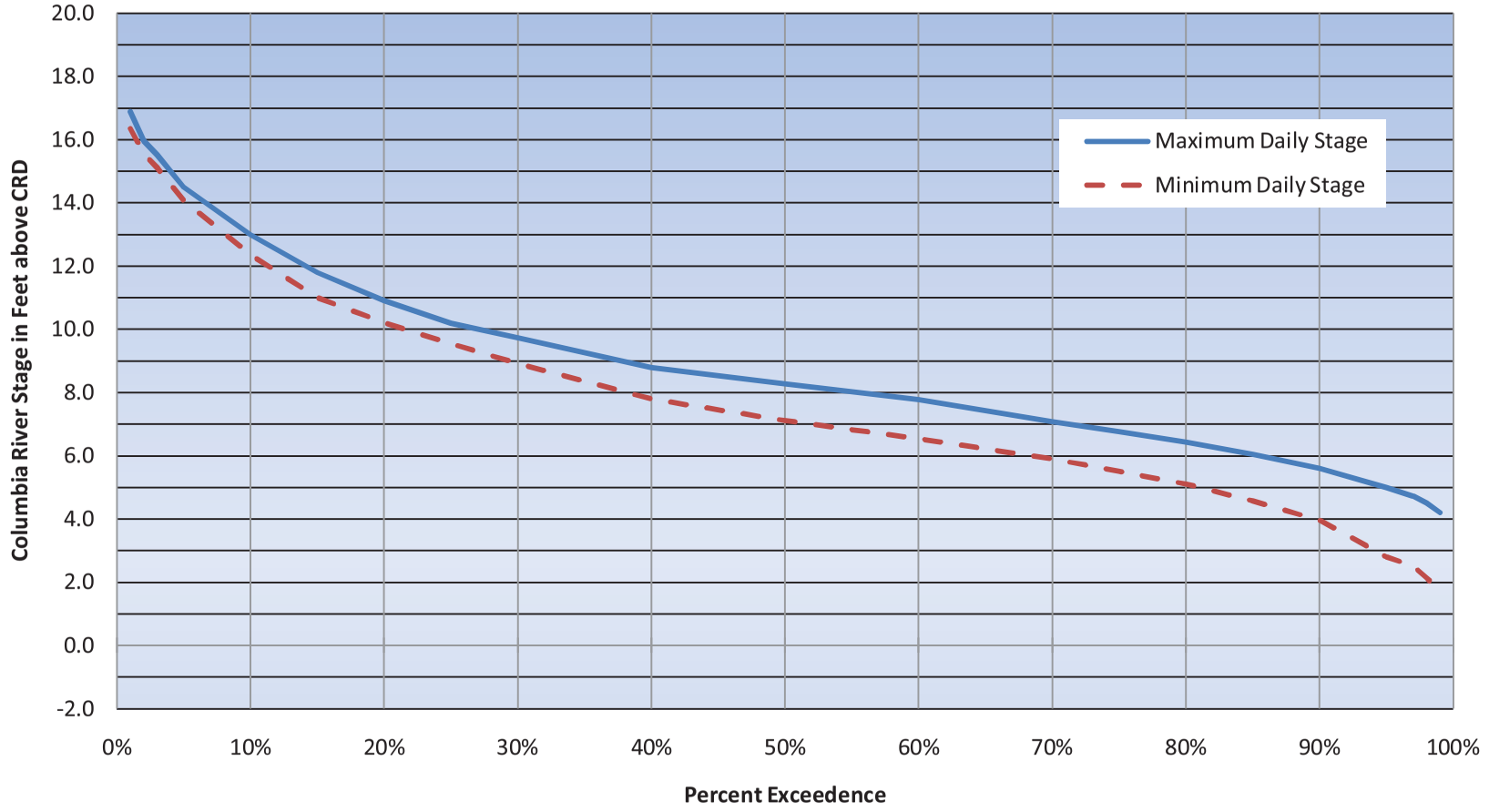
May
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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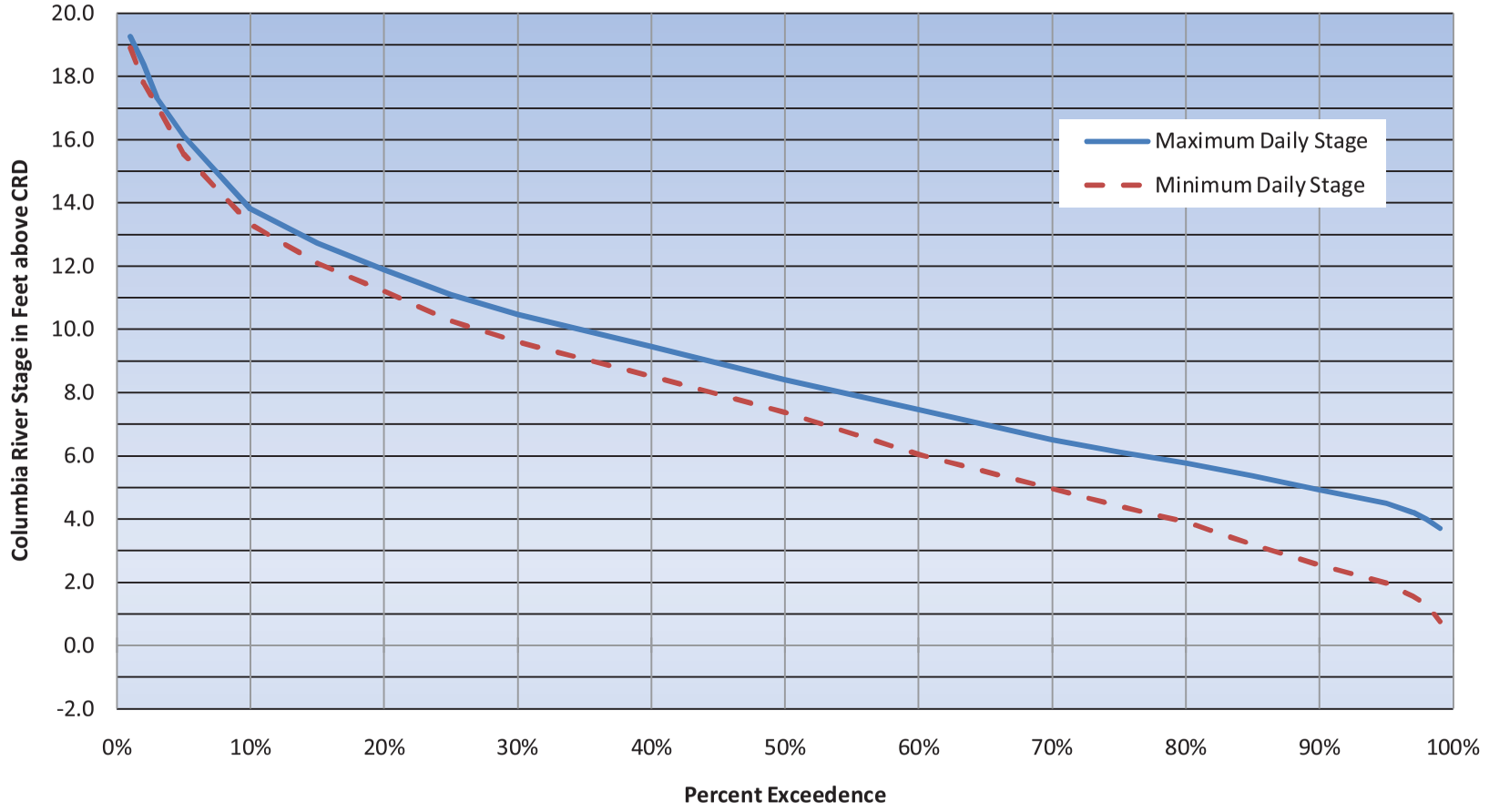
June
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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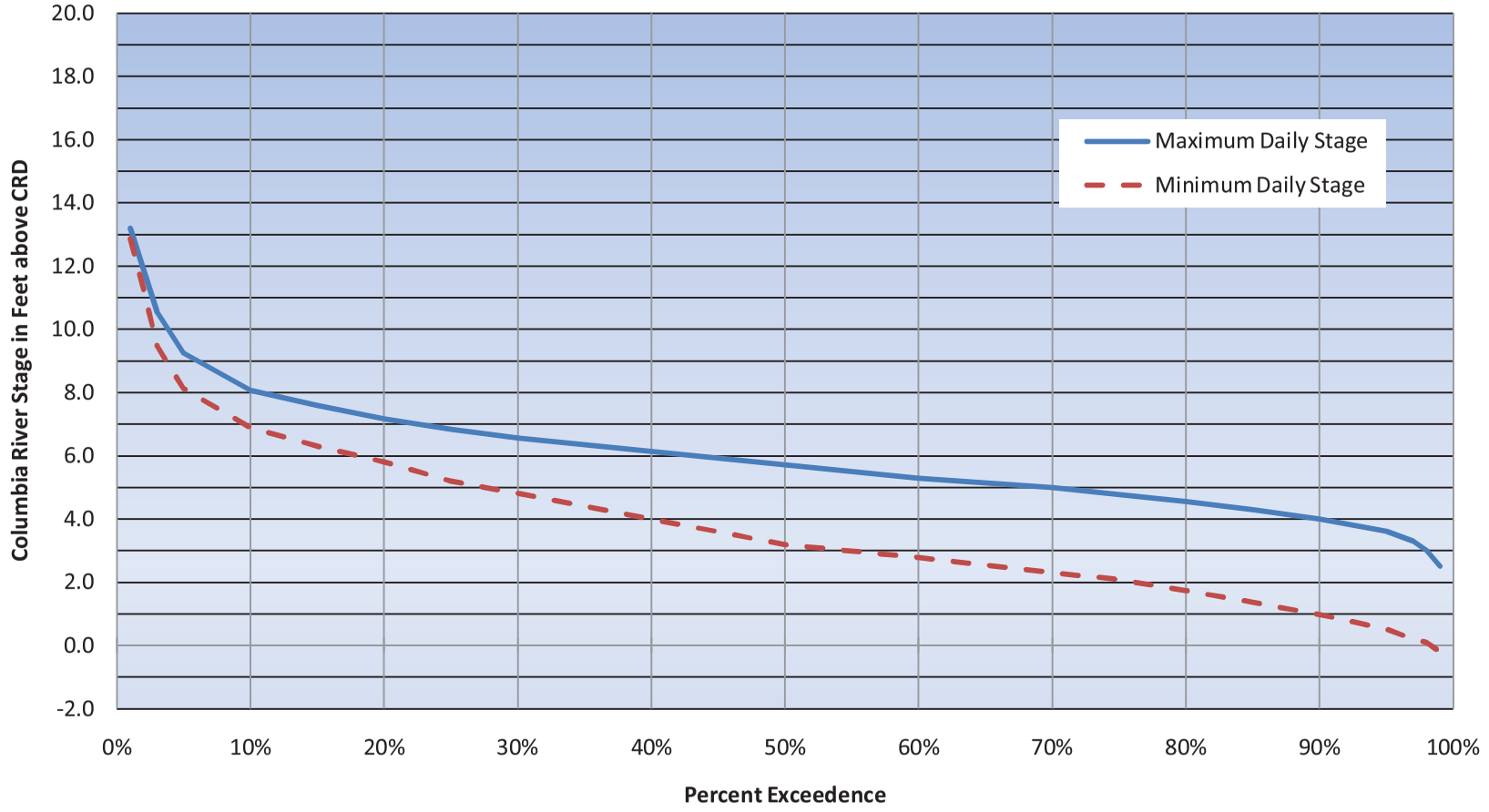
July
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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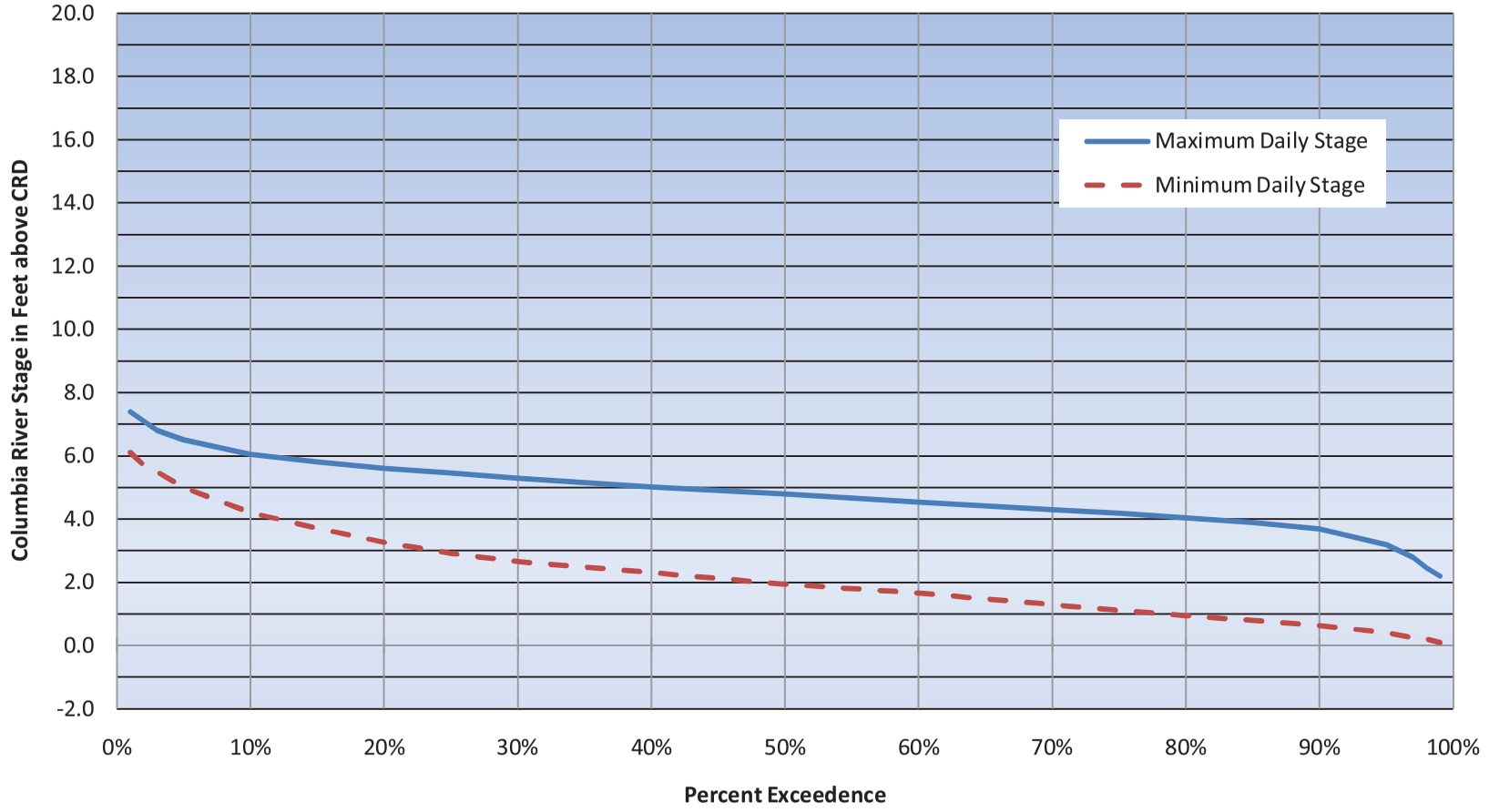
August
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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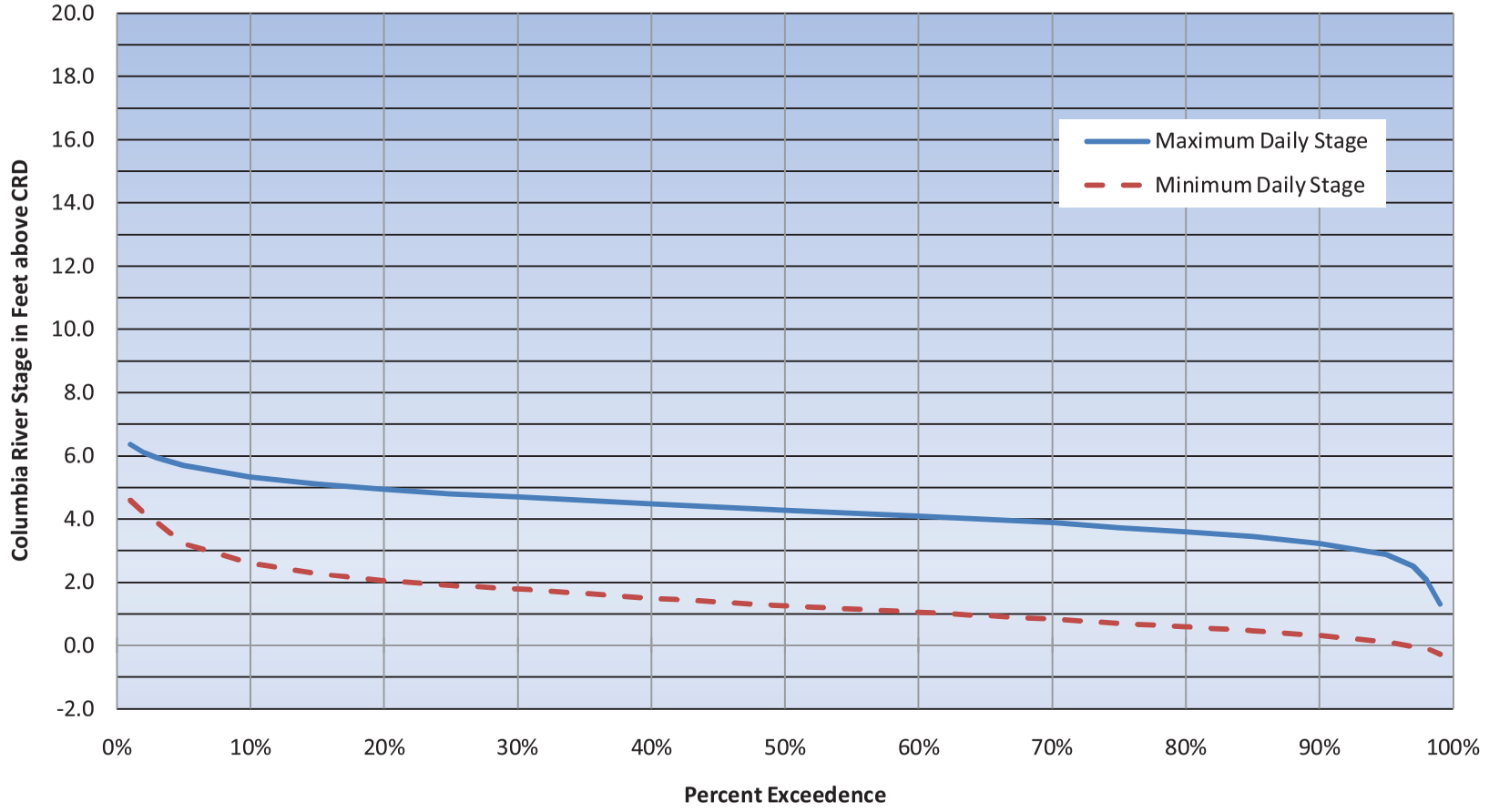
September
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
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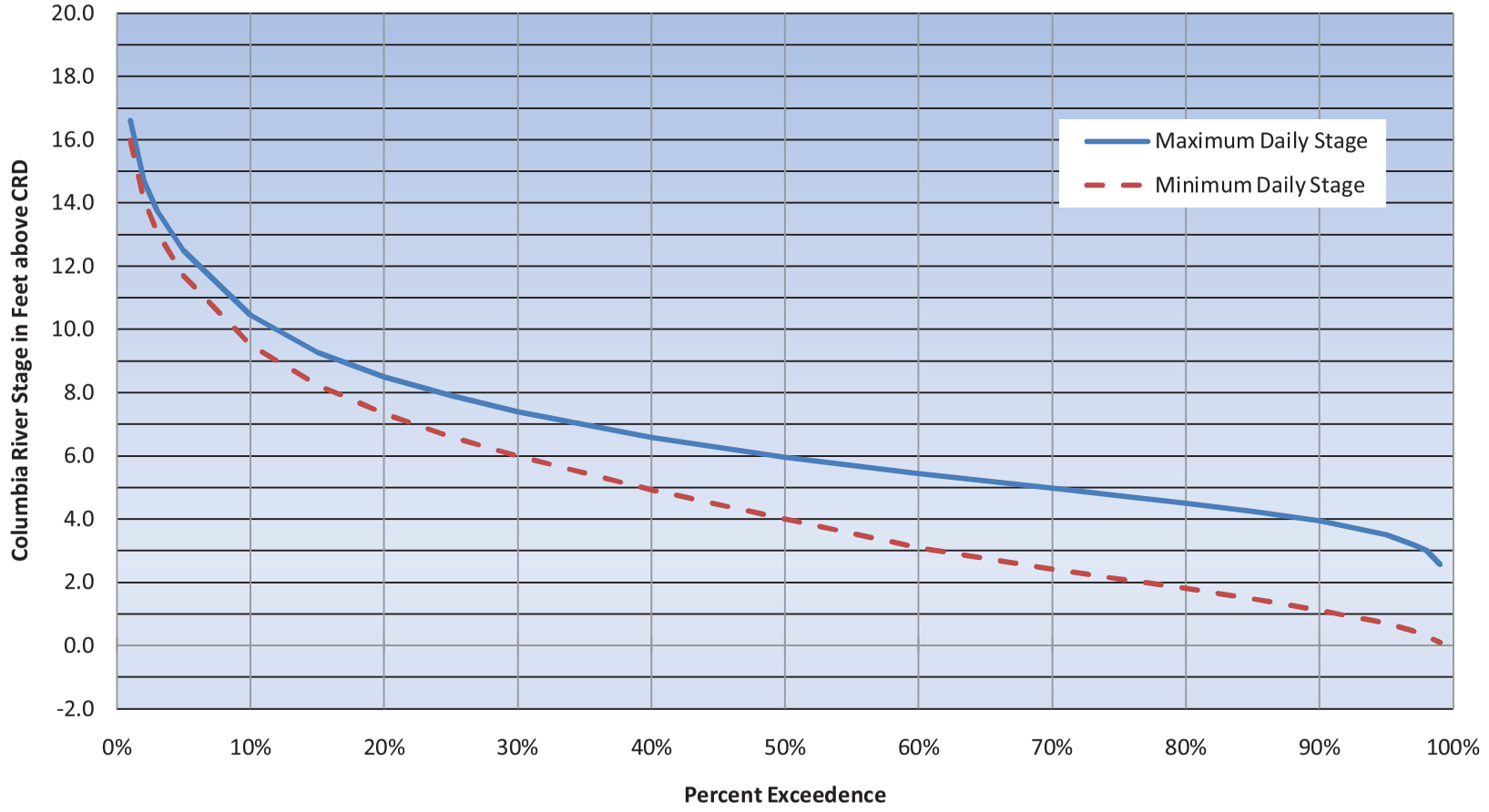
Annual
River Stage Exceedence
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
3. Missing data was estimated using either manual records or interpolation from known data.
4. Columbia River datum at River Mile 106.4 is 5.25 feet above NAVD 1988 and at River Mile 103.8 is 5.10 feet above NAVD 1988.

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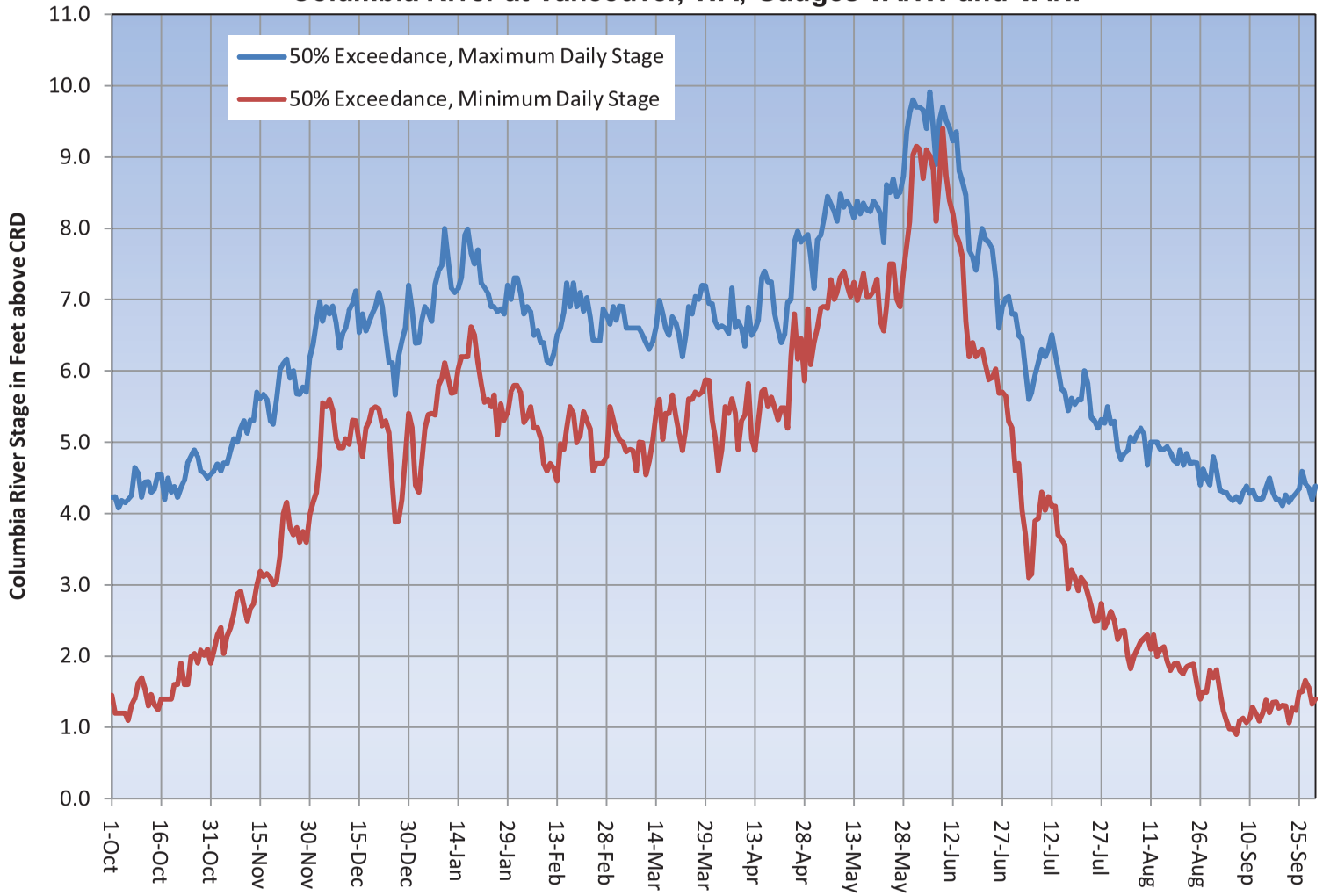
11/16/2011

River Stage Exceedance
Columbia River at Vancouver, WA; Gauges VANW and VANP



Notes:

1. Data obtained from the U.S. Army Corps of Engineers and U.S. Geological Survey websites.
http://www.nwd-wc.usace.army.mil/perl/dataquery.pl?k=columbia+river+at+vancouver
http://nwis.waterdata.usgs.gov/or/nwis/uv/?site_no=14144700&PARAmeter_cd=00065,00060
2. Period of Record: October 1972 - September 2011.
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