

Hydrographic Survey Chart Modernization Project (Charting with GIS)

Mel Littell

Engineering Technician (Civil)

USACE Portland District

WEDA

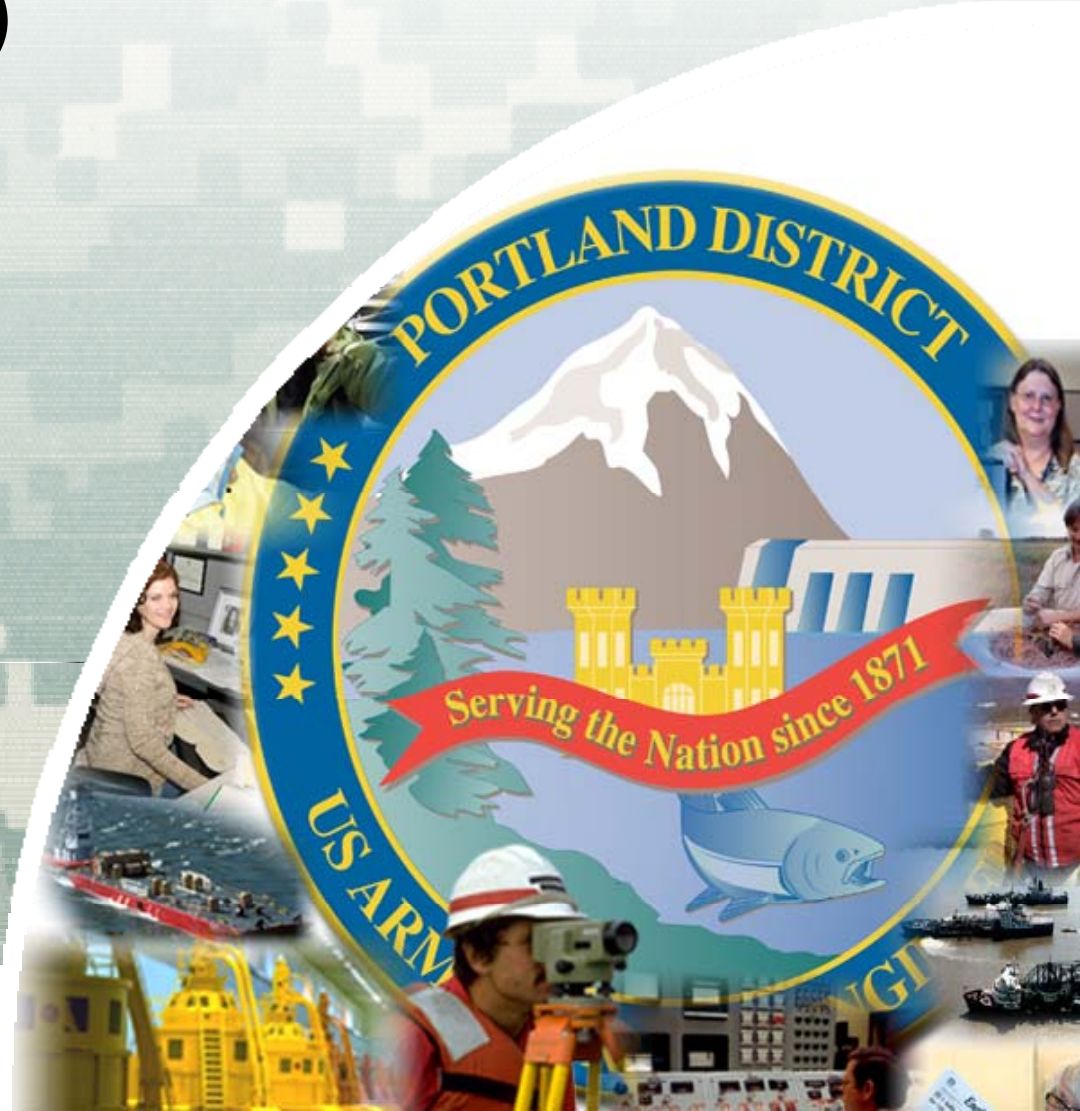
2011 Annual Meeting

Portland, Oregon

October 27, 2011



US Army Corps of Engineers
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Hydrographic Survey charting with GIS

The Hydrographic Survey Chart Modernization project at Portland District was initiated to streamline production of the hydrographic survey charts and their associated data sets. The intent was to modify the process from CAD (computer-aided design) based into a GIS (geographic information systems) driven process. This conversion allows for the processing of XYZ hydro-survey data to be automated, using a single software package, and opens the door to more efficient, accurate and standardized charts.



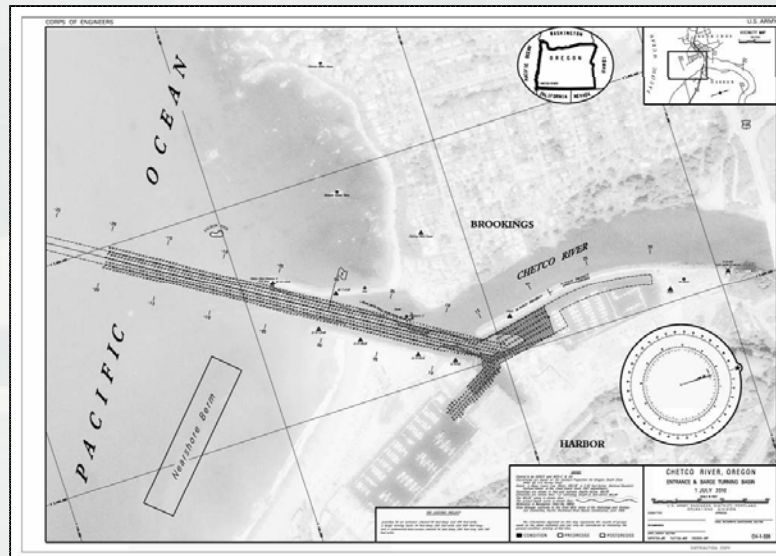
Hydrographic Survey charting with GIS

- History
 - ▶ CADD-based multi-software approach
 - ▶ 2009 GIS approach
- 2010 GIS approach
 - ▶ Introduction
 - ▶ The new process
 - ▶ Bonus materials
 -  Chart presentation



History – CADD approach

- Pre-existing process
 - ▶ Terramodel for processing labels, contours and hatching areas
 - ▶ Microstation for chart creation, review and plotting
 - ▶ Printed for visual inspection of all features
 - ▶ Channel status sounding labels “Visually Selected”
- Charts were “stand-alone” product
 - ▶ Different symbols
 - ▶ Different units
 - ▶ Difficult to maintain



CORPS OF ENGINEERS

LEGEND

ANCHORAGE AREA

ASTORIA

OREGON

ANCHORAGE AREA

COLUMBIA RIVER

UPPER SANDS

20 SEPTEMBER 2010

U.S. ARMY ENGINEER DISTRICT PORTLAND OPERATIONS DIVISION

REMARKS

CONDITION ☐ **PREDREDGE** ☐ **POSTREDGE** ☐

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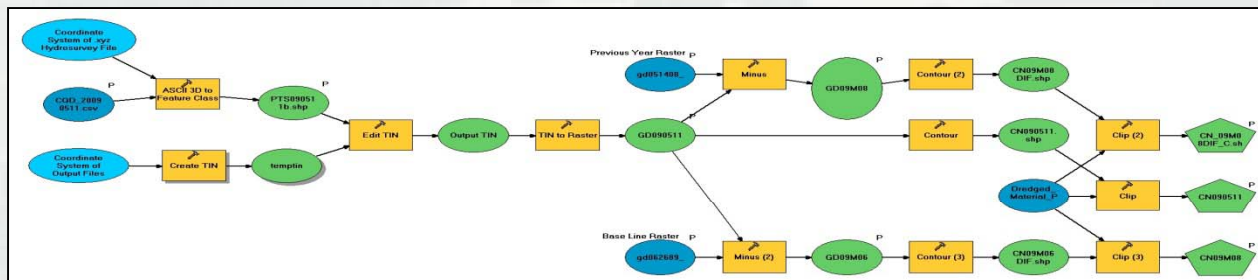
Hydrographic Survey charting with GIS

- Why change from CAD?
 - ▶ Maintenance of Master Charts is streamlined
no more different units, fonts, line work
 - ▶ 800+ surveys/year. Data to chart 40-60 minutes
(conditional, maintenance, and work for others)
 - ▶ Columbia River MCR to Vancouver 106 miles monthly
30 charts posted to the web page for the Columbia
River Pilots each month as soon as QA was
complete.
 - ▶ Visual selection of shoal points for CCR



History – 2009 GIS approach

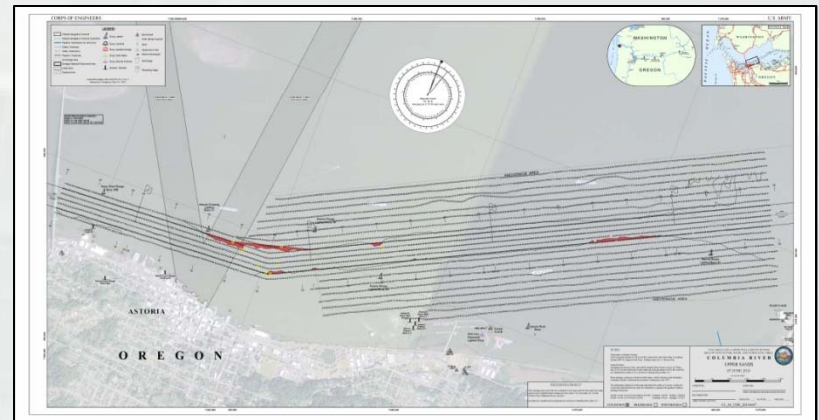
- 2009 approach attempted to eliminate operator input
 - ▶ ESRI's ModelBuilder utilized to geoprocess XYZ survey data
 - ▶ Chart templates called upon local and external data sources (i.e. Corps GIS databases and internet based imagery services etc.)
 - ▶ Utilized automated labeling processes and non-standard symbology
- Advantage - theoretically sound!
- Disadvantage – relied upon others (network, data stewards) and slow processing time
- Positive results – provided important RD&E



2010 GIS approach

■ Intention

- ▶ Improve upon 2009 methodology and streamline process to apply to all charts
- ▶ Create a flexible, production-based charting system
- ▶ Capitalize on ARRA-funded Navigation and Coastal Databank (NCDB) GIS analyst team's expertise



2010 GIS approach

- Accomplished using two parallel tasks
 - **XYZ Survey Data Processing**
 - ▶ Simultaneous evaluation ModelBuilder & Python scripting
 - ▶ Extensive data manipulation and business process improvements required
 - ▶ OD-NH oversight and QA/QC throughout project
 - **Cartography**
 - ▶ Each chart created in GIS with OD-NH oversight
 - ▶ Manage all chart data with GIS data management methodology
 - ▶ Costliest and most visible part of project (products for public distribution)



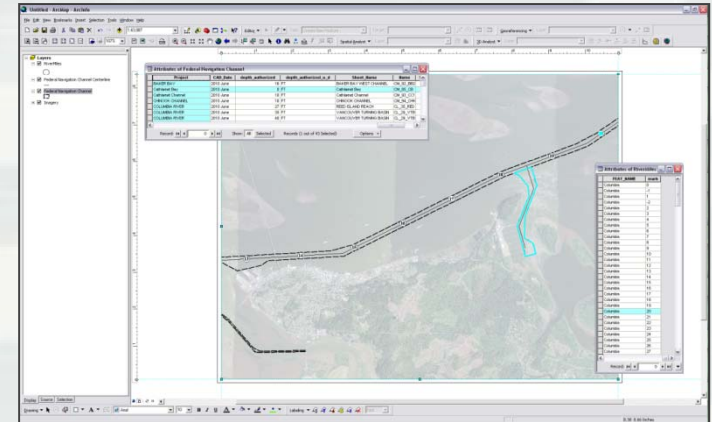
GIS data creation

- USACE data verification process

- ▶ Creation of GIS datasets called for analysis of existing NWP channel framework data
- ▶ Automation required end to end file naming structure standardization

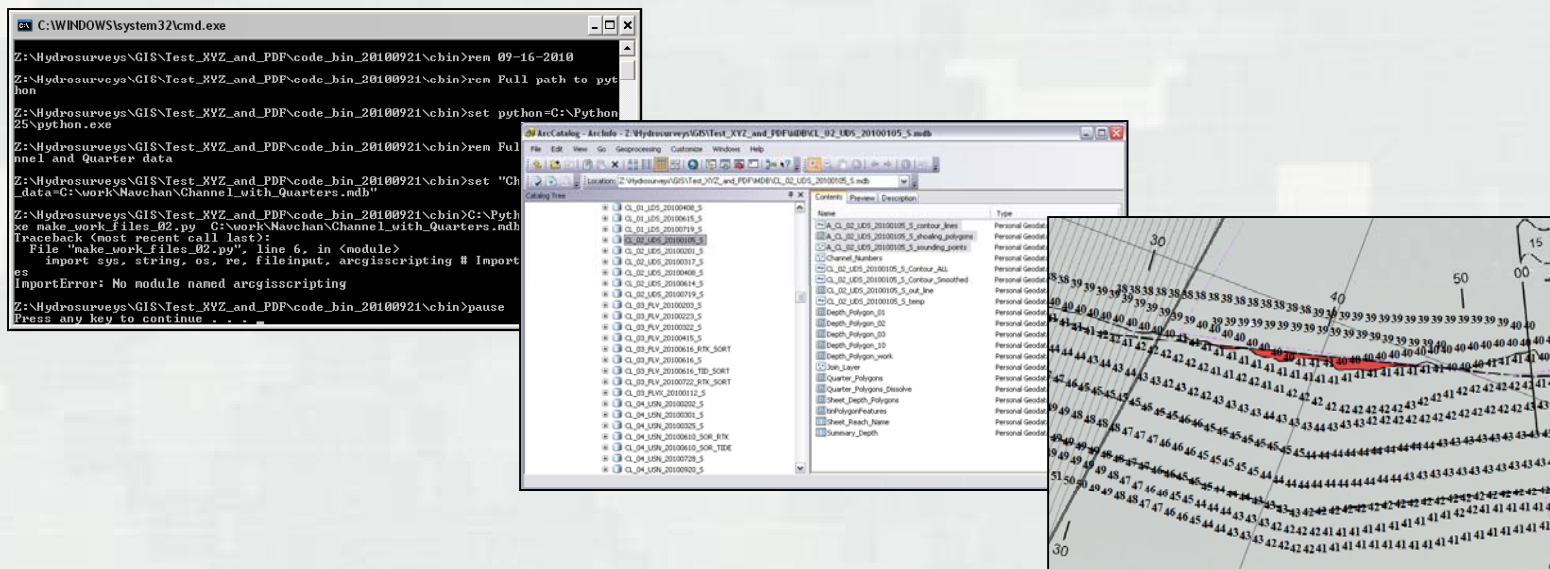
- OD-NH certified GIS data include:

- Federal navigation channel framework
- Corps river miles
- Horizontal control points
- Pile dikes
- Dredged material placement areas



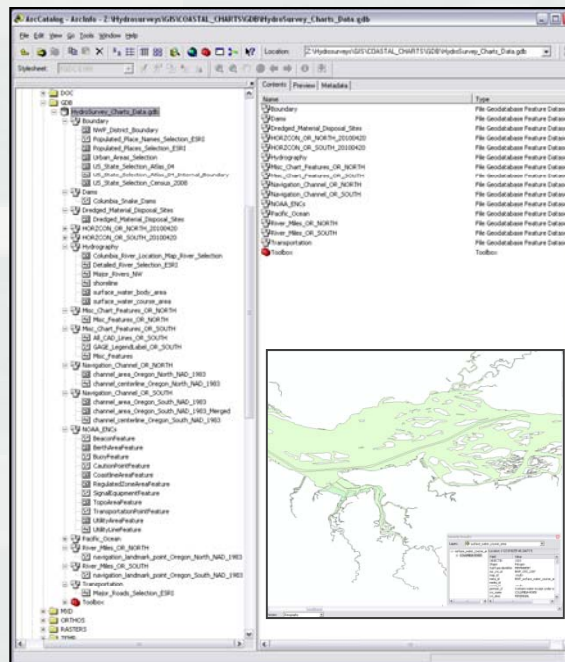
Geoprocessing XYZ data

- Python programming language with ArcGIS
 - ▶ Script automates the XYZ data processing, using ArcGIS tools
 - ▶ Outputs sounding points, contour lines, shoaling areas, Channel Condition Report, and Ad Hoc volumes
 - ▶ Python used to manipulate chart template and export to PDF
 - ▶ Print chart for review (less than **10 minutes** per chart)



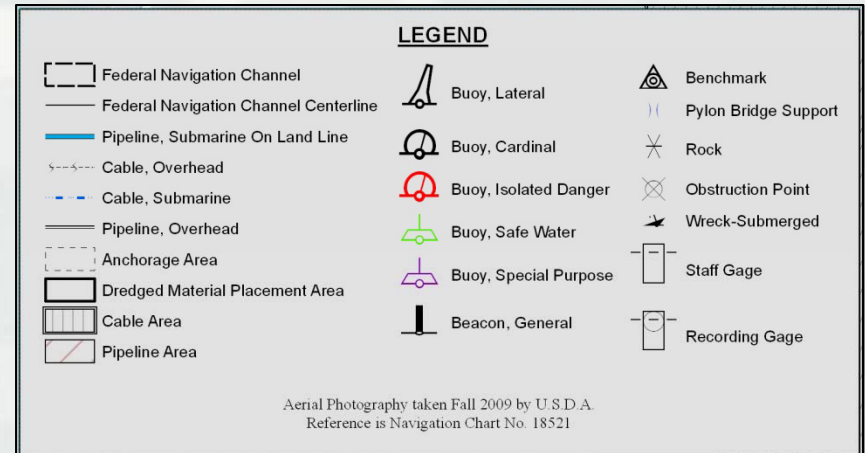
GIS data management

- Hydro-survey geodatabase/folder structure
 - ▶ Improves chart performance by directing all data layers to single data repository
 - ▶ Independent from other Corps GIS databases; allows for OD-NH management of chart specific data
 - ▶ Data updates can be easily integrated into charting system



GIS Data Management

- Multi-agency data usage
 - ▶ Allows standardization of data and symbols
 - ▶ Allows semi-annual updating of chart features
 - ▶ Removes duplication of data collection efforts

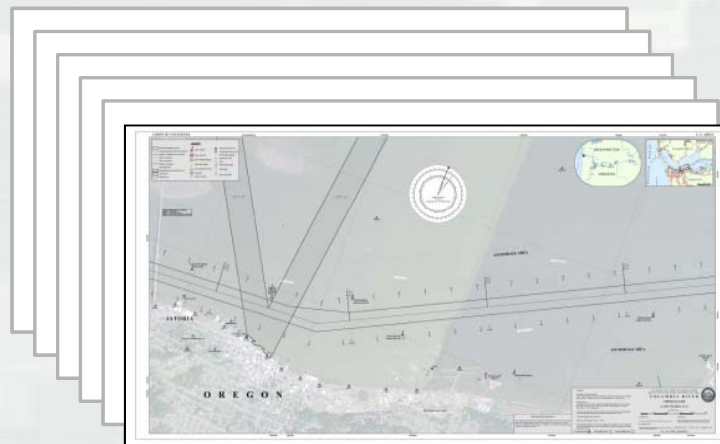


- NOAA Electronic Navigation Charts
- US Coast Guard Light List
- USDA/FSA NAIP Imagery
- USGS National Hydrography Dataset

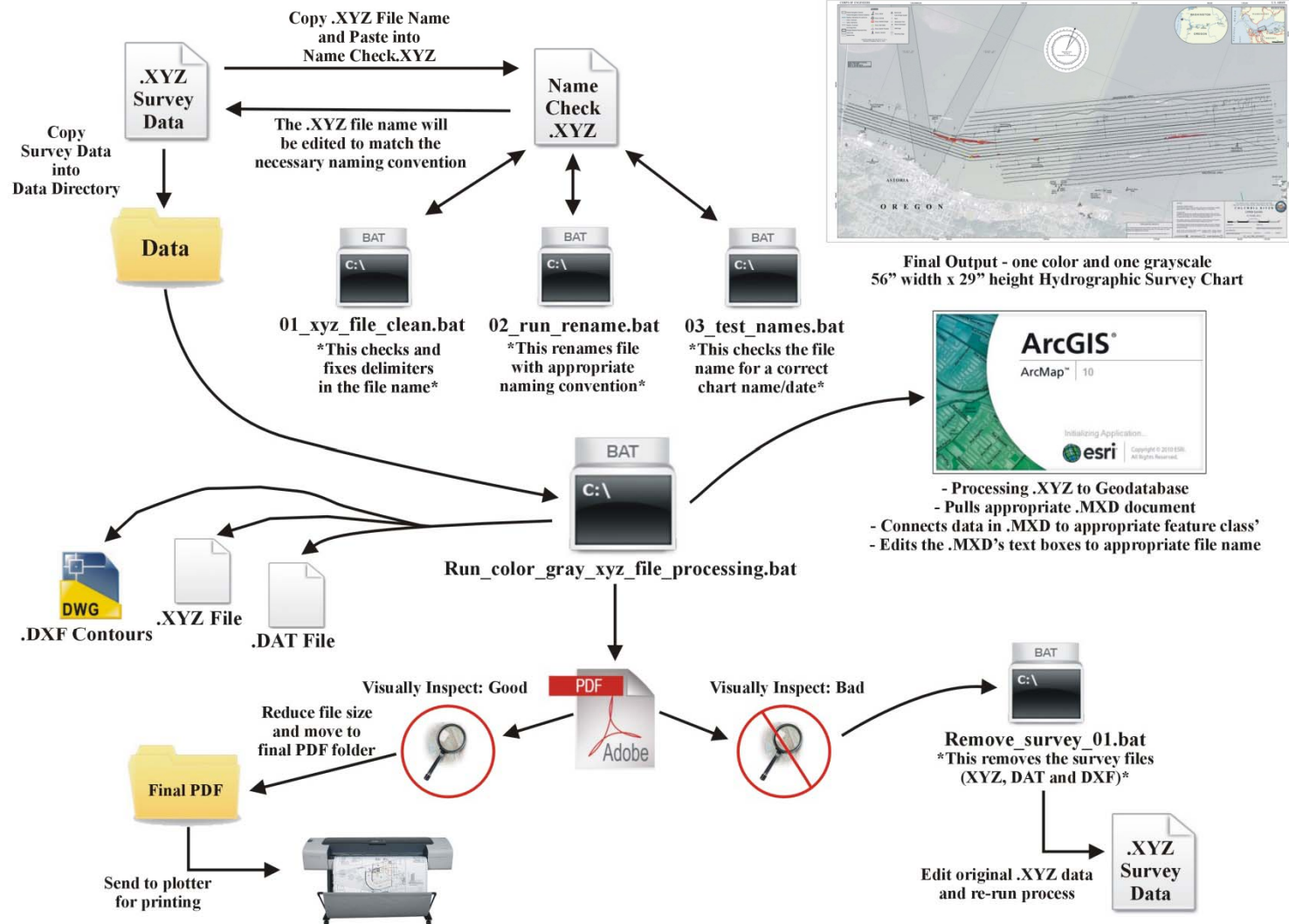


Digital cartography

- GIS chart templates created for all NWP managed Federal Navigation Channels
 - ▶ 56" wide x 29" high color and grayscale MXD's
 - ▶ Standard data, fonts and symbology on all charts
 - ▶ Standard map elements on all charts (title block, legend, scale bar, compass rose and inset maps)
 - ▶ Currently 221 of 355 chart templates are created

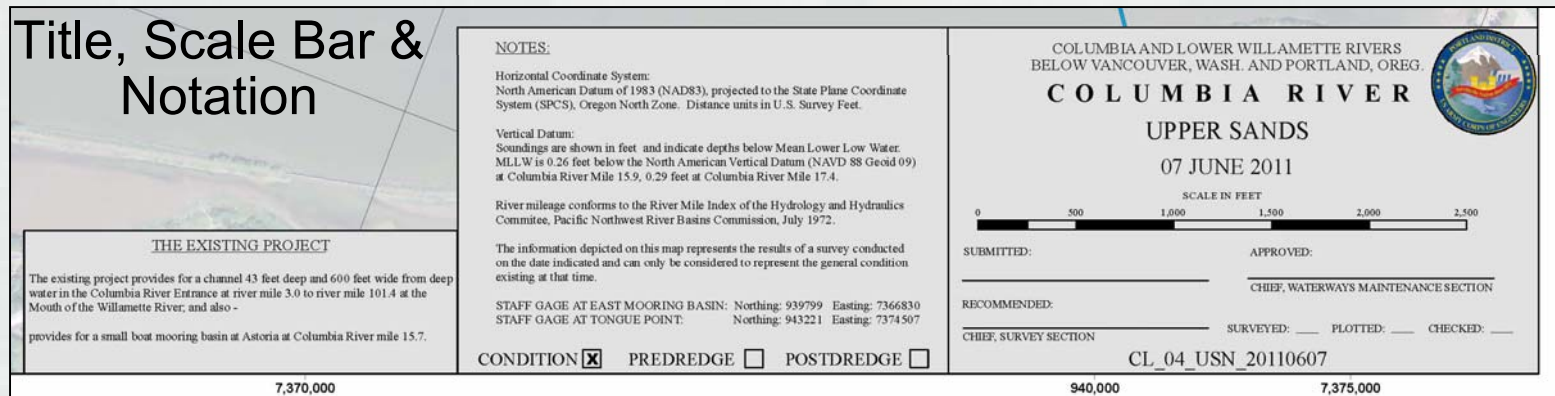
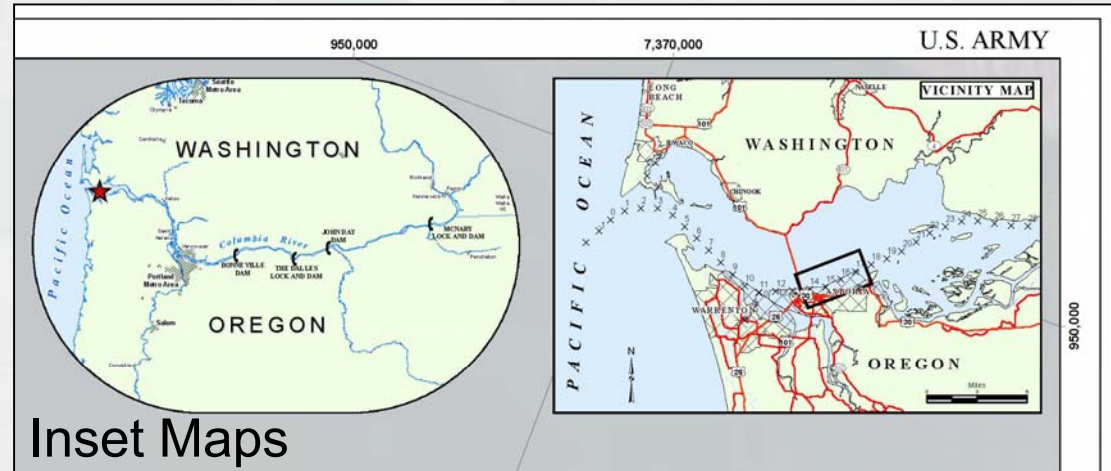
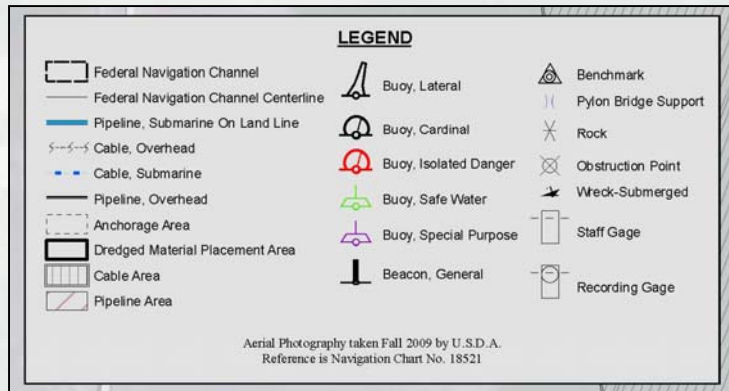


GIS Hydro-Survey Chart Creation Process



PORTLAND DISTRICT

GIS chart presentation

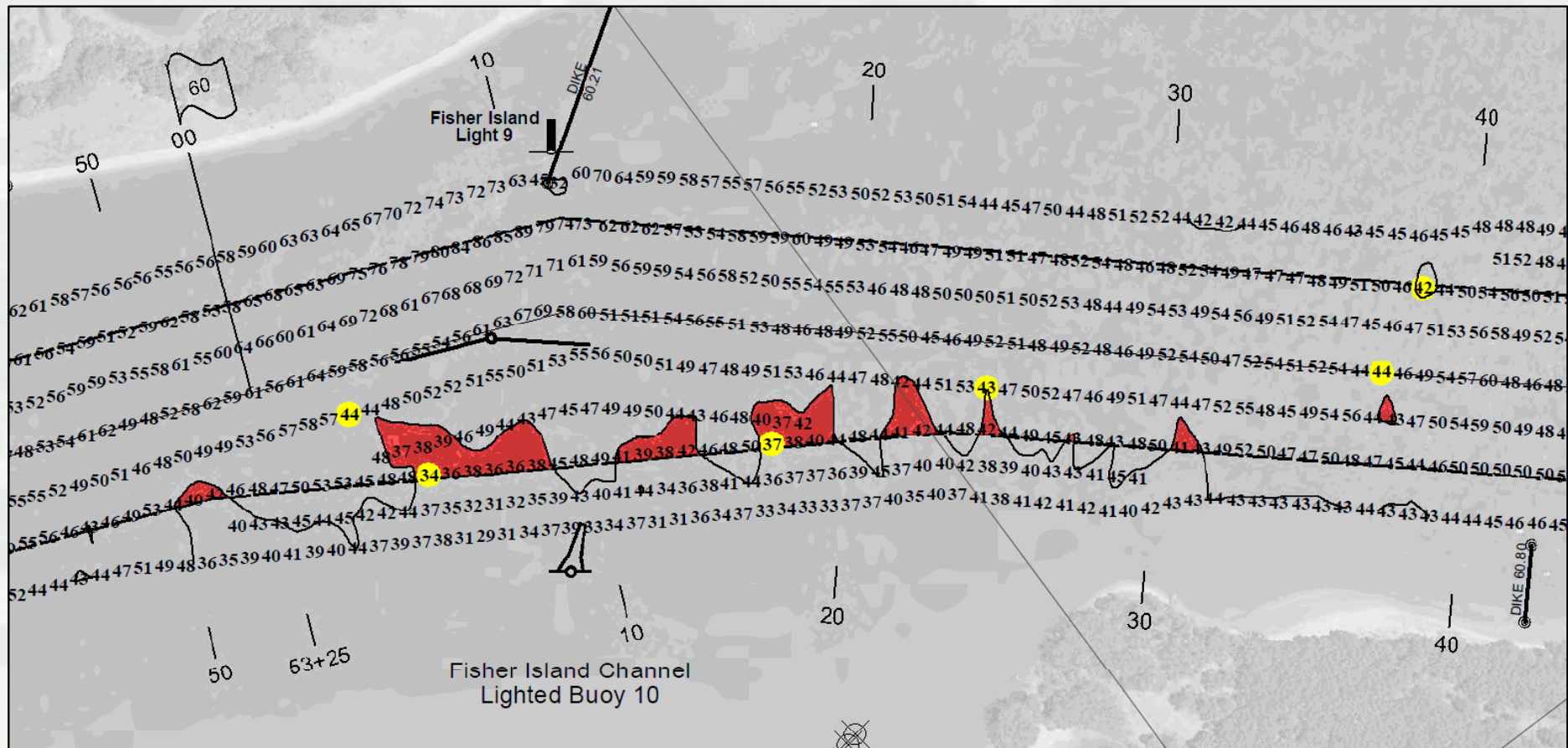


Channel Condition Report

06-Oct-11								
REPORT OF NAVIGATION CHANNELS					ER 1130-2-306			
COLUMBIA RIVER - OREGON & WASHINGTON MOUTH THROUGH PILLAR ROCK LOWER RANGE mile 25.2					Minimum depths in each 1/4 width of channel entering from seaward Mid-Channel			
Authorized Project NAME OF CHART Name of Channel (Mileage)	Date of Survey	Feet Width	Miles Length	Project Depth	Left Outside Quarter Feet	Left Inside Quarter Feet	Right Inside Quarter Feet	Right Outside Quarter Feet
MOUTH OF COLUMBIA RIVER	01-Sep-11							
Entrance Range		640	3.3	48	52	48	48	44
(-2.5 - 0.8)		2000	3.3	55	56	54	52	51
Sand Island Range		640	2.2	48	48	47	49	44
(0.8 - 3.0)		2000	2.2	55	54	54	50	49
LOWER DESDEMONA SHOAL	28-Sep-11							
Lower Desdemona Shoal		600	3.4	43	45	47	49	49
(3.0 - 6.4)								
UPPER DESDEMONA SHOAL	28-Sep-11							
Upper Desdemona Shoal		600	3.6	43	42	44	45	43
(6.4 - 10.0)								
FLAVEL BAR	27-Sep-11							
Tansy Point Turn & Range		600	3.6	43	41	43	43	34
(10.0 - 13.6)								
UPPER SANDS	10-Aug-11							
Tansy Point Turn & Range		600	1.2	43	42	45	45	43
(13.6 - 14.8)								
Astoria Range		600	2.7	43	42	44	44	43
(14.8 - 17.5)								



GIS chart presentation



Walker Island Reach CCR

WALKER ISLAND REACH	03-Oct-11							
Fisher Island Channel (59.4 - 60.2)	600	0.8	43	42	46	44	34	
Walker Island Channel (60.2 - 61.6)	600	1.4	43	42	44	43	37	
Barlow Point Channel (61.6 - 63.2)	600	1.6	43	47	49	48	45	
SLAUGHTERS BAR	22-Sep-11							
Slaughters Channel (63.2 - 65.4)	600	2.2	43	41	43	43	42	
Slaughters Turn & Turn Basin (65.4 - 67.1)	600	1.7	43	40	43	43	38	

ENG Form 4020-R (Nov 1990)

Reference is Navigation Chart No. 18523/18524.

Note: All Depths at Columbia River Datum.

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Ad Hoc Volumes Report

Columbia_Volumes_by_Reach_Quarter_20111012.xlsx - Microsoft Excel																
A234 f_x WILLOW BAR																
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Sheet_Name	R_Q_Name	Survey_Name	Shoal	VA_Auth	VA_Auth +1	VA_Auth +2	VA_Auth +3	VA_Auth +4	VA_Auth +5	VB_Auth	VB_Auth +1	VB_Auth +2	VB_Auth +3	VB_Auth +4	VB_Auth +5
2	MOUTH OF COLUMBIA RIVER	CL_00_MCR_1_A	CL_00_MCR_20110803.xyz	57	0	0	399	19395	92069	200726	4039233	3633742	3228651	2842156	2509339	2212505
3	MOUTH OF COLUMBIA RIVER	CL_00_MCR_1_B	CL_00_MCR_20110803.xyz	56	0	9	5157	34803	113710	244071	3616109	3151715	2692460	2257704	1872208	1538166
4	MOUTH OF COLUMBIA RIVER	CL_00_MCR_1_C	CL_00_MCR_20110803.xyz	55	27	1579	10848	43194	105081	207245	1276203	1056070	843652	654313	494514	374991
5	MOUTH OF COLUMBIA RIVER	CL_00_MCR_1_D	CL_00_MCR_20110803.xyz	53	12566	45364	111447	207779	327796	464699	1014471	826707	672227	547996	447451	363791
6	MOUTH OF COLUMBIA RIVER	CL_00_MCR_2_A	CL_00_MCR_20110803.xyz	53	26129	73995	152957	252353	367759	495602	2290705	2082703	1905799	1749328	1608867	1480844
7	MOUTH OF COLUMBIA RIVER	CL_00_MCR_2_B	CL_00_MCR_20110803.xyz	55	265	6325	46403	139171	254665	389777	4779526	4465741	4185974	3958896	3754545	3569812
8	MOUTH OF COLUMBIA RIVER	CL_00_MCR_2_C	CL_00_MCR_20110803.xyz	53	14679	49811	100570	160856	226761	298160	2250593	2138325	2041685	1954570	1873076	1797075
9	MOUTH OF COLUMBIA RIVER	CL_00_MCR_2_D	CL_00_MCR_20110803.xyz	51	108879	165273	227747	294605	363942	436377	1975765	1886917	1804150	1725766	1649861	1577054
10	MOUTH OF COLUMBIA RIVER	CL_00_MCR_3_A	CL_00_MCR_20110803.xyz	50	0	0	43	639	2683	10481	1110099	1006752	903448	800698	699394	603845
11	MOUTH OF COLUMBIA RIVER	CL_00_MCR_3_B	CL_00_MCR_20110803.xyz	48	76	1302	5999	15461	31710	52992	1038372	936542	838183	744588	657781	576006
12	MOUTH OF COLUMBIA RIVER	CL_00_MCR_3_C	CL_00_MCR_20110803.xyz	47	6316	17952	33973	54936	78785	106452	949102	857972	771228	689425	610508	535409
13	MOUTH OF COLUMBIA RIVER	CL_00_MCR_3_D	CL_00_MCR_20110803.xyz	44	54269	81490	111014	142094	176183	216334	895833	812991	732452	653470	577497	507584
14	MOUTH OF COLUMBIA RIVER	CL_00_MCR_4_A	CL_00_MCR_20110803.xyz	49	0	93	2871	13187	30785	54071	844047	784239	727116	677530	635227	598612
15	MOUTH OF COLUMBIA RIVER	CL_00_MCR_4_B	CL_00_MCR_20110803.xyz	47	1773	9344	24271	44861	70358	98536	950792	891201	838966	792394	750730	711747
16	MOUTH OF COLUMBIA RIVER	CL_00_MCR_4_C	CL_00_MCR_20110803.xyz	46	20716	38833	60954	86984	115325	144538	787455	739021	694591	654070	615860	578522
17	MOUTH OF COLUMBIA RIVER	CL_00_MCR_4_D	CL_00_MCR_20110803.xyz	44	70718	102242	136006	171438	208112	245900	540671	504430	470429	438097	407005	377029
18	LOWER DESDEMONA SHOAL	CL_01_LDS_1_A	CL_01_LDS_20110804.xyz	46	0	0	0	89	4245	17170	6331880	6146254	5960628	5775092	5593621	5420920
19	LOWER DESDEMONA SHOAL	CL_01_LDS_1_B	CL_01_LDS_20110804.xyz	48	0	0	0	0	0	1137	2145165	2044753	1944341	1843928	1743516	1644240
20	LOWER DESDEMONA SHOAL	CL_01_LDS_1_C	CL_01_LDS_20110804.xyz	49	0	0	0	0	0	0	2002537	1902607	1802677	1702746	1602816	1502886
21	LOWER DESDEMONA SHOAL	CL_01_LDS_1_D	CL_01_LDS_20110804.xyz	49	0	0	0	0	0	0	4510439	4301871	4093303	3884735	3676166	3467598
22	UPPER DESDEMONA SHOAL	CL_02_UDS_1_A	CL_02_UDS_20110809.xyz	43	2142	13335	32575	57204	91302	133638	772802	677395	590035	508064	435562	371297
23	UPPER DESDEMONA SHOAL	CL_02_UDS_1_B	CL_02_UDS_20110809.xyz	44	0	224	7591	25275	50315	85809	753787	647411	547979	459204	377703	306059
24	UPPER DESDEMONA SHOAL	CL_02_UDS_1_C	CL_02_UDS_20110809.xyz	45	0	0	167	10621	34407	73999	697160	590676	484359	388329	305631	238739
25	UPPER DESDEMONA SHOAL	CL_02_UDS_1_D	CL_02_UDS_20110809.xyz	43	6	1301	7017	23907	58132	104688	614940	509999	409479	320133	248122	188442
26	FLAVEL BAR	CL_03_FLV_1_A	CL_03_FLV_20110927.xyz	41	7171	22977	59797	142888	249689	359271	644513	524278	425058	372107	342868	316409
27	FLAVEL BAR	CL_03_FLV_1_B	CL_03_FLV_20110927.xyz	43	6	1679	20710	65146	133939	211059	605900	502606	416669	356138	319964	292117
28	FLAVEL BAR	CL_03_FLV_1_C	CL_03_FLV_20110927.xyz	43	32	3732	28320	67905	122866	195619	556734	454979	374111	308241	257747	225043
29	FLAVEL BAR	CL_03_FLV_1_D	CL_03_FLV_20110927.xyz	34	57318	95715	153814	222371	303130	404420	845405	700283	574864	459903	357144	274916
30	UPPER SANDS	CL_04_USN_1_A	CL_04_USN_20110810.xyz	42	3490	11399	24570	40868	58248	76210	394562	362519	335738	312084	289512	267522
31	UPPER SANDS	CL_04_USN_1_B	CL_04_USN_20110810.xyz	45	0	0	1200	8068	17075	27565	480918	443055	380976	354910	330326	30326
32	UPPER SANDS	CL_04_USN_1_C	CL_04_USN_20110810.xyz	45	0	0	1041	5521	11576	18910	500382	465001	430661	399761	370434	342387
33	UPPER SANDS	CL_04_USN_1_D	CL_04_USN_20110810.xyz	43	86	707	2870	6824	11930	18275	452578	417639	384241	352634	322179	292964
34	UPPER SANDS	CL_04_USN_2_A	CL_04_USN_20110810.xyz	42	1798	12969	48197	101287	168277	248335	187145	111632	60175	26581	6886	260
35	UPPER SANDS	CL_04_USN_2_B	CL_04_USN_20110810.xyz	44	0	3	11114	45382	92066	144956	269536	187760	117092	69580	34485	5596
36	UPPER SANDS	CL_04_USN_2_C	CL_04_USN_20110810.xyz	44	0	993	18366	54590	98664	151467	264929	183973	119398	73674	35799	6654
37	UPPER SANDS	CL_04_USN_2_D	CL_04_USN_20110810.xyz	43	2441	14777	41730	87604	145308	213737	206305	136560	81432	45225	20847	7195
38	TONGUE POINT CROSSING	CL_05_TNG_1_A	CL_05_TNG_20110915.xyz	38	50014	83230	122003	164043	208301	254679	194433	161758	134641	110790	89157	69645
39	TONGUE POINT CROSSING	CL_05_TNG_1_B	CL_05_TNG_20110915.xyz	41	9731	26994	55176	90539	128681	168568	249178	203038	167817	139777	114516	91000



Hydrographic Survey charting with GIS

- The benefits of using a GIS!
 - ▶ Automation of a repetitive process
 - 50-60 minutes per chart production time saved
 - Batch processing with unattended operation
 - ▶ Ease of maintenance
 - Ability to make global updates to charts
 - Standardization of data and symbols
 - ▶ Bonus information available
 - Channel Condition Report generated by software
 - Ad Hoc volumes used by PM to identify work needed
 - Data analysis of information stored in a Geodatabase



Thank you

